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Issue: Lead
Author: John Posey
Version: 12/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Lead**
Description of stressor	Lead is a heavy metal that is used in a variety of materials and products. Historically, it has been used in paint and plumbing products. Lead poisoning is the number 1 environmental threat to children. Lead is a neurotoxin that is especially dangerous to developing brains.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Although acute exposure can be fatal, this is relatively rare. Chronic exposure is especially dangerous to children. In children, lead poisoning can lead to learning disabilities, behavioral disorders, and lower IQ's. Lead is also harmful to the environment. Birds and mammals may face shortened lifespans because of poisoning from environmental lead. Animal studies have also revealed that lead may affect renal, cardiovascular and hematological dysfunction.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Medical costs associated with lead poisoning and lead paint abatement are significant. Aesthetic impacts, though harder to measure, are not trivial.
Key impacts selected (critical socio-economic effects)	Costs incurred, aesthetic impacts.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Humans can absorb lead through ingestion or inhalation. Persons living in residences containing lead-based paint can inhale microscopic lead particles, and humans can ingest or inhale microscopic portions of soil containing lead. Atmospheric lead is less significant now than it has been in recent years. The banning of leaded gasoline has reduced atmospheric levels by 98% (USEPA, 2000).
Quantification of exposure levels statewide	CDC (2000) estimates that about 4.4% of all preschoolers have elevated blood lead levels (defined as more than 10μg/dL). If the number of cases in NJ is proportional to its population, then we may expect about 25,000 preschoolers to suffer from elevated blood lead levels.
Specific socio-economic entities at increased risk	Children are much more strongly affected by lead exposure than adults. In addition, low income persons and minorities are at greater risk because these groups are more likely to live in older housing.
Quantification of exposure levels to entities at increased risk	Nationally, 4.4% of all children have elevated blood lead levels (defined as greater than 10 micrograms per deciliter). However, 16.4% of poor children living in older housing had elevated blood lead levels, and 21.9% of black children ages 1 to 5 who were living in older housing had elevated blood levels. (CDC, 2000).
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	To assess medical costs, I rely on government estimates of incidence and cost of lead poisoning.

Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: It is possible to speculate that lead levels would have an impact on property values. Potential home buyers would be rational to be concerned about lead paint, or lead in soil. However, appraisers and economists have apparently not studied this possibility. A search on Econlit, which claims to cover journals from 1969 to the present, revealed only 2 articles that contained the term "lead based paint." One of these presented regulatory recommendations from a HUD task force, and the other considered abatement methods in abandoned buildings. A Dow Jones search through issues of Appraisal Journal from 1994 to the present found only 2 articles containing "lead based paint," but these mentioned the topic only in passing. There were no articles in Real Estate Economics. Thus, it appears that lead poisoning has not yet come to the attention of scholars working in the field of real estate valuation. Research on this topic could prove fruitful. Rather than assuming without good evidence that needed lead abatement costs are capitalized into property values in NJ, we include those costs under the damage costs category below.	*1*
	Duration/irreversibility	1
	Scale: About 54% of NJ housing units were built before 1950 and may contain lead contamination. (1990 Census.)	3
	Uncertainty	3
Employment	Severity: EQTWG argues that lead in the environment can be harmful to birds and mammals. It is possible that this could have an impact on ecotourism employment or on jobs related to wildlife harvesting. However, the impacts cited by EQTWG do not appear to rise to a job-threatening level. Thus, employment impacts appear to be minimal.	*1*
	Duration/irreversibility	1
	Scale	1
	Uncertainty	1
Costs Incurred	Severity: NIH (2000) estimates that the annual cost of lead poisoning in the U.S. is $17.2 billion. This includes both direct medical costs ($11.5 billion), and indirect costs such as lost work days and reduced productivity ($5.7 billion). If NJ's share of these costs is proportional to its population, then the cost to the NJ economy is $516 million. An additional expense is the cost of lead paint abatement. I have been unable to find any discussion of the economic cost of abatement in NJ. However, the Consolidated Plan of the City of St. Louis estimates that the cleanup costs of lead paint in that city could amount to $1 billion, based on the estimate of 100,000 units * $10,000 per unit. If the cost of abatement in a city of 350,000 is as much as $1 billion, then the cost to the NJ economy in coming years could be much higher. NJCRP guidelines call for a score of "3" to be given to any impact with a cost greater than $160 million.	*3*
	Duration/irreversibility: Cleanup is expensive and time-consuming. The effects of lead poisoning are permanent.	3
	Scale: Lead should be considered a statewide problem. Some news reports indicate that the suburbs may account for 20% of all lead poisoning cases.	3
	Uncertainty: I am fairly confident that annual costs exceed $160 million.	2
Aesthetic Levels	Severity: EQTWG indicates that lead poses a potential threat to biodiversity and biological integrity. Birds and mammals appear most at risk. Wildlife can be damaged by lead in soil from historical pollution, or by lead in water. Although these impacts might concern persons observing wildlife, they are not likely to be considered more than a low aesthetic impact.	*1*
	Duration/irreversibility: Lead contamination of soil can be very long-lasting.	3
	Scale: This appears to be a statewide problem.	3

	Uncertainty: The subjective nature of these judgments makes my uncertainty level fairly high.	3
Psychological Impacts	Severity: Parents would not be irrational if they worry about lead poisoning, since 11.5% of children in older housing in large urban areas suffer from elevated blood lead levels (CDC, 2000). Moreover, popular news sources have frequent reports on the problem of lead poisoning, which helps to make the public aware of this problem. It is not unreasonable to believe that urban parents face a moderate degree of worry about lead poisoning.	*2*
	Duration/irreversibility: Damage associated with lead poisoning can be irreversible.	3
	Scale: Worry about this problem is probably greatest in urban areas, though some reports indicate that 20% of lead poisoning cases occur in suburbs.	2
	Uncertainty: It is difficult to have a high degree of certainty about such an amorphous concept.	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: It would be useful to see econometric research on property values that includes the presence of environmental lead as an independent variable in a hedonic regression. Additional testing and monitoring would allow more precise estimates of the number of children affected.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ Blood levels have dropped 75% in the last 30 years, and atmospheric lead levels have dropped 98% (EPA, 2000). These improvements resulted primarily from elimination of leaded gasoline, but also from growing awareness of the dangers of lead paint. However, lead in soil can be very expensive to clean up, and can persist for long periods of time. The danger of lead poisoning will not be completely eliminated in the foreseeable future.	
Potential for catastrophic impacts (H,M,L) and brief description	L: This is a severe chronic problem rather than one with acute catastrophic potential.	
Incidence of impacts (affected sub-groups, variability, equity issues)	Lead poisoning is a classic environmental justice issue. While the blood lead level has dropped in children nationwide, it is still dangerously high for poor children. 21.9% of black children ages 1 to 5 who live in older housing have elevated blood lead levels. 16.4% of poor children living in older housing have elevated blood lead levels. 11.5% of children living in older housing in large urban areas have elevated blood levels. Overall, 4.4% of all children have elevated blood lead levels.	
Extent to which threat is currently regulated	See Federal and State regulations, below.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	M: Industrial uses of lead contribute to water and soil contamination.	
Small business industry	M: Industrial uses of lead contribute to water and soil contamination.	

Transportation	H: Historically, atmospheric lead levels have been caused primarily by leaded gasoline. However, leaded gasoline has been largely banned for 20 years, and atmospheric levels have dropped by 98%. Soil contamination today results largely from past uses of leaded gas.
Residential	H: Homes built before 1950 still contain large amounts of lead based paint, and still contain some plumbing with lead.
Agriculture	L
Recreation	L: There are several potential recreational sources of lead. First, lead shot used for hunting waterfowl may contribute to the level of lead in wetlands. Second, leaded gasoline is still allowed for certain off-road vehicles, boats and race cars. (Bonanno, 2001).
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	M: Abandoned housing and industrial sites frequently contain leaded paint and contaminated soil.
Diffuse Sources	
Sediment sinks	L
Soil sinks	H: Lead from leaded gasoline remains in soil, where it can come into contact with children.
Non-local air sources incl. deposition	L
Biota sinks	L
References	Alliance to End Childhood Lead Poisoning. "About Lead Poisoning." www.aeclp.org Bonanno, Linda. DEP Air Toxics Scientist. Telephone Conversation, 9/5/2001. Howard Mielke. "Lead in the Inner Cities." *American Scientist*, volume 87, January-February 1999. Joel Schwartz. "Societal Benefits of Reducing Lead Exposure." *Environmental Research*, volume 66, 1994. U.S. Census Bureau. 1990 U.S. Census Data STF3C. www.census.gov U.S. Census Bureau. 1999 State Population Estimates. www.census.gov U.S. Center for Disease Control. "Facts on Lead." www.cdc.gov/nceh/lead/. 2000. U.S. EPA. "Lead and Lead Paint." www.epa.gov/region02/health/leadpoisoning.html. 2000. U.S. National Institutes of Health. Disease-Specific Estimates of Direct and Indirect Costs of Illness and NIH Support. 2000.

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Current Policy and Regulatory Framework	
Federal	Lead is regulated by OSHA, ACGIH, NIOSH, DOT, DEP, IARC, HHAG and EPA. Leaded gasoline and paint have been virtually banned.
State & Local	Lead is listed as a hazardous substance by the NJ Department of Health and Senior Services. Firms are required to report all uses and emissions of lead under the state Right to Know act.

Lead is the number one environmental threat to children. Lead is a powerful neurotoxin that is especially dangerous to developing brains. Statewide, an estimated 25,000 pre-schoolers suffer from elevated blood lead levels. The annual medical costs associated with lead poisoning in NJ are estimated to be over $500 million. This cost does not include the billions of dollars that it will ultimately cost to abate lead contamination. Lead is also damaging to wildlife. It would not be irrational for urban parents to suffer some psychological impacts from worrying about lead poisoning.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	3	1	2
Duration/ Irreversibility	1	1	3	3	3
Scale (spatial, population)	3	1	3	3	2
Subtotal Risk	3	1	27	9	12

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
10.4	**10.4**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	3	1	2	3	3	2

Trend: +

Catastrophic Potential: L

Issue: Legionella
Author: John Posey
Version: 10/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Legionella**
Description of stressor	Legionella is a bacteria which can cause legionnaires' disease (legionellosis) or Pontiac Fever.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Legionnaires' Disease is a pneumonia-like illness that can be fatal.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Medical costs relating to legionnaires' disease are the only direct socio-economic impacts considered.
Key impacts selected (critical socio-economic effects)	Costs Incurred
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Legionnaires' disease is contracted by inhaling water vapor that contains legionella. Legionnaires' disease can only be contracted by inhaling fairly large amounts of the bacteria. In natural conditions, legionella cannot reproduce quickly enough to cause legionnaires' disease. Human-made environments, though, can provide breeding grounds that allow legionella counts to grow to dangerous levels. In particular, heating-ventilation-air conditioning (HVAC) systems are generally connected to the development of dangerous legionella counts, and to the transmission of legionella to humans.
Quantification of exposure levels statewide	HHTWG estimates that 237-533 cases of legionnaires' disease occur in NJ each year, of which 12-15 are fatal. NJDHSS reports that there are about 33 reported cases each year; HHTWG notes that cases are thought to be underreported by an order of magnitude.
Specific socio-economic entities at increased risk	The disease most often affects middle-aged and older persons. Those who smoke cigarettes, drink heavily, have chronic lung disease, or lowered immune system resistance due to underlying disease or chemotherapy are at higher risk of becoming ill.
Quantification of exposure levels to entities at increased risk	Same as statewide.
Dose/Impact-Response Assessment	

Quantitative/Qualitative impact-assessment employed	Review of cost-of-illness literature related to pneumonia and influenza.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	a) Severity: No impact hypothesized.	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1
Employment	a) Severity: No impact hypothesized.	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1
Costs Incurred	a) Severity: Considered here are the direct medical costs related to legionnaires' disease. According to CDC, there is no specific treatment for Pontiac Fever. Cost estimates specifically for legionnaires' disease were not available. However, since legionnaires' is similar to pneumonia, it was assumed that costs associated with legionnaires' are similar to costs associated with pneumonia. According to NIH, there are 81,500 deaths from pneumonia and influenza each year. The direct medical costs associated with these conditions are $18.2 billion. This amounts to $223,312 per death. HHTWG reports that there are 12-15 deaths each year in NJ caused by legionnaires disease. If legionnaires disease costs are similar to pneumonia costs, then the total economic cost is between $2.70 million and $3.35 million: $223,312 * 12 = $2.70 million. $223,312 * 15 = $3.35 million. NJCRP guidelines call for a score of "1" to be given to any impacts less than $16 million.	1
	b) Duration/irreversibility: HHTWG finds that 15-30% of cases are fatal. This might be considered a moderately reversible disease.	2
	c) Scale: The problem is statewide. However, the population actually affected in any given year is very small.	1
	d) Uncertainty: I am moderately confident that the cost of legionnaires is less than $16 million.	2
Aesthetic Levels	a) Severity: None hypothesized.	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1
Psychological Impacts	a) Severity: Since Legionnaire's Disease was highly publicized in NJ because best known episode occurred in nearby Philadelphia, a residual concern persists.	1
	b) Duration/irreversibility:	1
	c) Scale:	1
	d) Uncertainty	1

Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	HHTWG gives this question a ranking of "L."
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0: There is little evidence, either way.
Potential for catastrophic impacts (H,M,L) and brief description	L: (Following HHTWG rankings)
Incidence of impacts (affected sub-groups, variability, equity issues)	Unknown.
Extent to which threat is currently regulated	HHTWG reports the following: *Legionella* are specified as one of the pathogenic microbes controlled, through disinfection and filtration, by the USEPA Surface Water Treatment Rule (USEPA, 1989). All public surface water treatment facilities in the State comply with the SWTR requirements. In addition, for ground water source systems, NJ regulations require that community water systems (but not non-community water systems) disinfect their water. However, ingestion of drinking water is not considered to be significant direct source of infection. The NJ Department of Health and Senior Services (DHSS) has several regulations aimed at the control of *Legionella* (NJAC 8:57; 13.4(c)). Legionellosis is a reportable disease in NJ (Fishman, 1999) meaning that physicians, hospitals and other health care providers are required to report all known cases of the disease to the DHSS. Indoor air quality regulations control building air handling equipment maintenance as well as regulations specifically addressing microbial contamination (NJAC 12:100-13). *Legionella* growth in water systems can be controlled through the implementation of preventative procedures (CDCb; see footnote 4).
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	M: Office buildings and hotels
Small business industry	M: Office buildings and hotels

Transportation	L
Residential	M
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	M
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	M: According to HHTWG: "*Legionella* are obligate parasites of free-living protozoa."
References	National Institutes of Health. Disease-Specific Estimates of Direct and Indirect Costs of Illness and NIH Support. 1997. NJ Department of Health and Senior Services. "What You Should Know about Legionellosis." http://www.state.nj.us/health/cd/f_legion.htm. 1999.
Current Policy and Regulatory Framework	See "regulation," above.
Federal	
State & Local	

Issue: Legionella
Author: John Posey
Version: 10/00

Legionella is a bacteria that causes Legionnaires' Disease, a pneumonia-like illness that can be fatal. Most legionella is spread through HVAC systems. HHTWG estimates that there are 237-533 cases in NJ each year, of which 12-15 are fatal. The economic cost to the NJ economy is estimated at $2.70 million to $3.35 million. This is considered a low impact under NJCRP guidelines. No other socio-economic impacts are hypothesized.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	0.1	1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	0.1	1	0.1	1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.46	**0.46**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	3	1	1	1.4

Trend: 0

Catastrophic Potential: L

Issue: Light Pollution
Author: John Posey
Version: 01/01

NJ Comparative Risk Project
Socio-economic Technical Work Group
Stressor-Specific Risk Assessment

Light Pollution

The Socio-economic Technical Work Group elected to produce a "paragraph" rather than a full writeup on this issue because it is so difficult to quantify economic costs associated with light pollution.

There are two types of impacts associated with light. First, light towers can harm birds in two different ways: a) birds can die when they collide with light towers, or when they become disoriented by city lights and crash into other buildings; and b) light from towers can affect migratory patterns, and thereby decrease biodiversity. The second type of problem is the aesthetic impact of light pollution.

Effect on birds: An advocacy group cited by the Ecological Work Group, Towerkill.com, claims that between 1 million and 5 million birds die each year after colliding with towers in mid-flight. A major problem is that of communications towers which are lit at night for aviation safety.
Nationally, there are about 40,000 light towers. In NJ, there are about 300. If NJ has an amount of bird kills proportional to its towers, then NJ experiences 7,500 to 36,500 bird deaths each year. This may understate the problem, however, since NJ lies on a major flyway.

In addition, towers can interfere with bird migrations. One study indicates that birds are attracted to light towers on cloudy nights, but avoid them on clear nights. If these alterations in migration were permanent, then biodiversity could be affected. Unfortunately, there is no direct evidence regarding specific birds affected by light towers in NJ, nor is there direct evidence concerning the number of bird deaths each year.

It is possible to speculate about the socio-economic impacts that bird deaths and migration patterns might have. However, it should be stressed that these impacts are speculative. Additional research to determine the precise effect of light towers on birds in NJ would be beneficial.

Costs Incurred: There are two ways that bird deaths could lead to higher costs. First, dead birds could serve as breeding grounds for harmful bacteria and the mosquitoes that spread them. However, in the absence of guidance from HHTWG, SETWG may reasonably assume that the public health impact is minimal. A second source of costs is the cost of cleaning up dead birds. If most tower owners hire groundskeepers to maintain the land on which the towers are located, then these groundskeepers could probably add the cleanup of bird corpses to their normal duties. This might not be pleasant for the groundskeepers, but there is little reason to believe that it would pose measurable additional costs.

Property Values: If residential properties located near towers were deluged with bird corpses, then this could decrease the attractiveness of property. However, there is no evidence that this has actually occurred in NJ.

Worry: If people see dead birds lying about, they may worry about the cause of death. This is especially true when fears of the West Nile Virus are active. There is no direct evidence that bird corpses have caused mass panic in NJ, however.

Employment: Certain areas of the state, such as Cape May, benefit economically from bird watchers. If light towers altered migratory patterns, then this could result in the loss of ecotourism in Cape May. To date, there is no direct evidence that this has occurred. However, the concern justifies additional research on the effect that NJ light towers have on bird migration.

Aesthetic Impact: The aesthetic impact of bird losses is not trivial. Most people consider it unpleasant to see dead birds. More importantly, the possible effect of light towers on bird migrations could deprive areas of certain bird species. This would be a regrettable circumstance for anyone who values biodiversity.

Issue: Light Pollution
Author: John Posey
Version: 01/01

Light Pollution: The proliferation of nocturnal lights has dramatically decreased the number of stars visible in much of NJ. It is difficult to evaluate, in any quantitative way, the aesthetic impact of the loss of visible stars. However, an advocacy group called the International Dark Sky Association (IDSA) has been formed to lobby against light pollution. The group claims over 3000 members, and has been awarded a grant from the National Science Foundation. The group argues that more efficient lighting would be both cost-effective and protective of night skies. The IDSA home page includes a number of eloquent testimonials from persons saddened about the loss of night sky visibility. In addition, Sky and Telescope Magazine has a regular feature devoted to fighting light pollution. These efforts give credence to the belief that the aesthetic impact of light pollution is not trivial, and that this sentiment is shared by a growing number of people.

Additional evidence of the aesthetic importance of light pollution is the growing number of local ordinances designed to combat light pollution. In the U.S., there are at least 26 local ordinances dealing with light pollution. Eatontown, NJ, in Monmouth County, has passed an ordinance declaring misdirected or unnecessary light to be a public nuisance. The ordinance requires that lights be shielded and directed downward to prevent glare or "light trespass." In addition, the town of Biseicho, Japan, has produced a similar ordinance designed specifically to preserve the view of the night sky. The town has drawn more than 10,000 visitors since the ordinance went into effect, evidence that the night sky holds deep aesthetic qualities for large numbers of people.

In 1997, the New Jersey Light Pollution Study Commission issued a report. Its recommendations were based on four key principles: 1) Most glare can and should be prevented. Glare affects the ability of drivers to perceive objects or obstructions clearly. Particularly sensitive to this problem are elderly drivers. 2) Energy is wasted when excessive levels of illumination are used. Inefficient luminaires can spill unwanted light well outside of the intended target area. 3) Light trespass may be viewed as an invasion of privacy. Most obtrusive lighting conditions can be avoided. 4) Inappropriate use of outdoor lighting can deteriorate the natural nighttime environment, particularly in areas preserved for wildlife. In addition, sky glow reduces the ability to observe the starry night sky.

The growing level of concern in NJ and around the world indicates that light pollution can reasonably be considered at least a moderate aesthetic impact. In NJ, the problem exists statewide. Given the large number of light fixtures that would have to be replaced in order to cure light pollution, it would appear that any solution would have to be implemented over many decades. The problem may be most irreversible in areas located within 50 miles of New York City and Philadelphia.

References:

"Facilitating Star-Gazing: Light Control Legislation in Beseicho." Global Development Research Center. http://www.gdrc.org/uem/japan/biseicho.html

John Batinsey. "New Jersey Light Pollution Study Commission Recommendations. International Dark Sky Association, Information Sheet 121. April, 1997. http://www.darksky.org/ida/ida_2/info121.html

"Eatontown, NJ Outdoor Lighting Ordinance." International Dark Sky Association, Information Sheet 92. http://www.darksky.org/ida/ida_2/info92.html

Light pollution and light towers: Light towers can be bad for birds. First, birds can die when they collide with towers in mid flight. An advocacy group claims that this causes 1 to 5 million bird deaths nationally each year. Second, lights can affect the migratory patterns of birds. If the alteration of migratory patterns persists, then biodiversity in a region could be affected. There is no direct evidence indicating that bird deaths have measurable socio-economic impacts. There is also no direct evidence that migratory patterns in NJ have been affected by towers. However, additional research is warranted, especially on the effect of towers on migration.

Light pollution also dramatically decreases the number of stars visible in NJ. Light pollution is a topic which is drawing an increasing amount of attention. The growing concern over light pollution indicates that it may be considered a moderate aesthetic impact, and one which is widespread and long-lived.

Issue: Light Pollution
Author: John Posey
Version: 01/01
Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	0.1	2	0.1
Duration/ Irreversibility	1	1	1	2	1
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	0.2	0.2	0.2	8	0.2

Average Risk (0 – 5 years)	Average Risk (5 years plus)
1.76	1.76

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	2	1	1.2

Trend: ---

Catastrophic Potential: L

Issue: Mercury
Author: Clinton Andrews
Version: 04/16/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Mercury (Hg)** including Hg0, ionic/inorganic (largely Hg++), and organic (largely methylmercury (MeHg)
Description of stressor	Mercury is found naturally in the environment in several forms. In its elemental form, it is a shiny, silver--white, liquid metal used in thermometers and some electrical switches. It can be combined with other elements to form inorganic compounds. Mercury can evaporate to form colorless, odorless mercury vapors. Mercury can combine with organic material to form organic compounds such as methylmercury, which is produced primarily by bacteria and is the form which poses the greatest concern for environmental exposure.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	**Hg^0**, **Hg^{++}** and **MeHg** have neurotoxicity, kidney toxicity and developmental neurotoxicity, respectively. They have the potential to cause adverse effects in all people. There is a fish advisory on mercury for women of childbearing age. Mercury bioaccumulates in humans. When a woman becomes pregnant, any mercury that has accumulated in her body may be released into the bloodstream. This can expose the fetus to mercury. Because mercury is a developmental neurotoxin, fetuses are particularly vulnerable to being harmed by exposure to mercury. In addition, different forms of exposure of mercury in the ecosystem will damage ecological structure and functions in certain ways. Because mercury is primarily found in water and fish, there is a potential risk to well water and fish consumers in New Jersey as well as a potential risk to the fishing and tourism industries.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values; Income; Employment; Costs Incurred; Aesthetic Levels; and Worry.
Key impacts selected (critical socio-economic effects)	Employment, costs incurred, worry.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Medical costs and worry are the two key socioeconomic impacts of mercury. The Human Health TWG has identified several relevant exposure routes: **Hg^0** -inhalation of vapor inside residences resulting from spills and intentional releases (associated with folk/religious practices); inhalation of Hg^0 released from dental amalgams. There are currently no data from NJ on the number of people exposed to Hg^0 in dwellings, or the number of dwellings contaminated with Hg^0. According to Human Health TWG, the data on the use of Hg^0 in folk/religious practices in other states is

	not appropriate for the extrapolation of these values to estimates of persons exposed in NJ. **Hg^{++}** - consumption of contaminated private well water (note – municipal supply wells are sampled regularly, and detection of Hg^{++} at concentrations above the Maximum Contaminant Level (MCL, 2 µg/l) results in elimination of that source). According to the Human Health TWG, the total number of persons exposed in NJ to well water exceeding the MCL is likely to be greater than 1,000. **MeHg** - maternal consumption of contaminated NJ freshwater and marine fish, and commercial fish from various sources (including imports) during pregnancy. The Human Health TWG estimates that approximately 11,000-24,000 infants per year in NJ are exposed *in utero* to quantities above the official reference dose. http://www.state.nj.us/dep/dsr/mercury-698.doc http://www.state.nj.us/dep/dsr/mercusgs.pdf	
Quantification of exposure levels statewide	Spatial: **Hg^0** and **Hg^{++}** exposures are highly localized. **MeHg** exposure affects a much broader population. Temporal: Absent cleanup efforts, exposures could be persistent.	
Specific socio-economic entities at increased risk	**Hg^0**- Latin American and Caribbean immigrants and those of Latin American and Caribbean descent **Hg^{++}** - Consumers of private well water drawn from the Kirkwood-Cohansey aquifer. **MeHg** - children born to mothers with elevated consumption of high Hg containing fish (Note: African-Americans appear to be at less risk as a result of reduced intake of high Hg containing fish). As is the case with many toxins, children are particularly vulnerable to mercury. The Central Nervous System (CNS) continues to develop throughout childhood. Since mercury is a CNS toxicant, mercury exposure can be more harmful to children than to adults.	
Quantification of exposure levels to entities at increased risk	For exposure levels to human health, it is the same as the Human Health TWG.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	No definite and accurate data can be cited at this time.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score

Property Values	Severity **Hg^0**- Low. **Hg^{++}** - Low. Mercury is found in some wells in the Pinelands areas of Atlantic and Ocean counties. Per-household costs of installing water filtration systems are a few thousand dollars apiece (see section on costs incurred below). Given this easy remediation option, it is unlikely that property values are affected. **MeHg** - Low	*1*
	Duration/Irreversibility Remediation activities can be taken. Well water could perhaps be filtered, or public water supplies brought to the affected residences.	1
	Scale The problem is most serious in Pinelands area, though wells in the whole state are affected. In total, it is estimated that the problem may affect a few thousand people, representing much less than one percent of homes statewide.	1
	Confidence There has been much research on the environmental science of mercury, but very little on its socioeconomic impacts. Nevertheless, we are fairly certain of this impact assessment because the problem's potential breadth is limited by the number of households relying on wells.	1
Employment	Severity **Hg^0**- Low. **Hg^{++}** - Low. **MeHg** - Low There may be harmful effects because certain species or locations may no longer be fished commercially and for pleasure. This hurts both the tourism and fishing industries. We think that the employment impact will be low because fishermen can easily switch to alternative species and locations The following calculation illustrates a plausible scenario. We assume that fishing-related economic activity declines in NJ by 20% as a result of **MeHg** levels. According to the 1997 *County Business Patterns* for all of NJ: <u>Commercial Fishing</u> Fishing, hunting, and trapping (SIC Code 0900) employs 188 and has an annual payroll of $5,474,000 at 78 establishments. Manufacturing of fresh or frozen prepared fish (SIC Code 2092) employs 379 and has an annual payroll of $6,652,000 at 8 establishments. Wholesale trade in fish and seafood (SIC Code 5146) employs 864 and has an annual payroll of $27,851,000 at 108 establishments.	1

	Recreational Fishing Hotels and other lodging places (SIC Code 7000) employs 74,313 and has an annual payroll of $1,742,925,000 at 1,396 establishments. We assume that 10% of this business is tied to recreational fishing (7431 employees; $17,429,250; 140 est.). Marinas (SIC Code 4493) employs 853 and has an annual payroll of $24,718,000 at 216 establishments. Summing these categories, employment is 9715 and has an annual payroll of $82,124,000 at 550 establishments in NJ. Loss of 20% of this business yields 1943 employees, $16,424,800 in payroll, and 110 establishments. Assuming that indirect employment impacts will roughly double the above estimate, the employment impact (0.12% employment loss, 0.03% earnings loss, 0.10% loss of establishments) of **MeHg** pollution remains relatively minor at the state-wide level (which totals 3,300,923 employees, $116,409,839,000 annual payroll, 229,349 establishments). The Socioeconomic technical working group characterizes losses of less than 20,000 jobs as low impacts.	
	Duration/Irreversibility The mercury bioaccumulates in a fish population and will take a while to reverse. However, there is a high degree of substitutability for the fishing activities involved.	1
	Scale This problem affects a variety of freshwater and marine species of commercial and recreational interest.	2
	Confidence Less confident about this, since not much literature is available and baseline data is not sufficient.	2 .
Costs Incurred	Severity: Low Damage to human health is the major effect of mercury pollution. Damages from three agents are as the follows: **Hg^0** - at anticipated levels of residential exposure, adverse neurologic effects may reach the level of frank symptoms. Some possible symptoms may not be reversible (depending on the length of exposure). Effects on the developing fetus (maternal exposure during pregnancy) may not reversible. If people exposed to high **MeHg** levels require hospitalization @$8783 per visit (DRG Code 035), then hospitalization costs could become significant; however, we have no basis for estimating the size of this population. **Hg^{++}** - at anticipated levels of residential exposure, adverse renal effects may be mild and reversible. The cost of remediating contaminated wells represents the minimum social investment that must be made. The average remediation for mercury contaminated wells is between $1,000 and $1,500. However, we do not know how many contaminated wells (with level above MCL) statewide. Using the Human Health TWG estimate that at least 1000 NJ residents are affected, this suggests that at least $1,000,000 are needed to remediate these wells. **MeHg** - at currently observed levels of exposure, effects on adults and developing fetuses, are likely to be subtle. Adult-type effects may be at least partly reversible. Effects due to *in utero* effects are probably not reversible. Assuming that 1% of the 11,000-24,000 infants per year exposed to high **MeHg** levels require hospitalization @$8783 per visit (DRG Code 035), then hospitalization costs are $966,130-$2,107,920 annually.	2

	Schwartz (1994) estimates that the secondary social costs of lead exposure outweigh the direct health care costs. If that is also true for mercury, then the calculations above are a serious underestimate. Compensatory education for 11,000-24,000 neurologically affected children @$3320/child = $37-80 million. Lost earnings @$1300/child (involves expected value calculation, too) = $14-31 million. In sum, we estimate that costs incurred due to mercury pollution are on the order of $2-113 million or more per year in NJ. Assuming that secondary social costs are at the low end of Schwarz's range, this places us in the Medium category.	
	Duration/Irreversibility: Medium	2
	Scale Subpopulations throughout the whole state are potentially affected.	1
	Confidence We have medium confidence because of the data difficulty.	2
Aesthetic Levels – no significant impact.	Severity	*0.1*
	Duration/irreversibility	1
	Scale	1
	Confidence	1
Psychological Impacts	Severity Causes problems for some of those who practice the Santeria folk religion. Also affects some communities where there are a lot of contaminated wells.	*2*
	Duration/Irreversibility Mercury could simply not be used in these practices.	1
	Scale Limited only to those who practice these religions and those in the polluted areas.	1
	Confidence We have modest confidence in it.	2
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	Though general information about mercury pollution and effects is available, specific information is needed in terms of the estimations of property value loss, income loss and cost incurred, such as medical cost and the relationship between mercury concentration and property value loss. **Hg^0 - H** - Based on very preliminary estimates from N.Y. City and CT., significant percentages of the Latin American and Caribbean populations could use and be exposed to Hg^0 in residences. **Hg^{++} - M** - Given non-random and geographically incomplete sampling of Hg levels in groundwater, additional contaminated drinking water sources and affected populations may be identified. **MeHg - L** - Data on exposure levels and size population exposed in NJ is of good quality and reflects two separate and independent assessments [9,10]. Data for high-end fish consumers may show greatly elevated exposure levels, but will reflect exposure in <1% of the general population, or the population of pregnant women. Based on this information, there will not be much change for socio-economic impacts.	

Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0
Potential for catastrophic impacts (H,M,L) and brief description	Low for all forms of Hg.
Incidence of impacts (affected sub-groups, variability, equity issues)	5% of NJ adults take MeHg above RfD level. 20% of women of childbearing age have MeHg intake above RfD level. >1,000 persons in NJ exposed to levels above the MCL in drinking water (2 μg/l), mean Hg concentration for those exceeding the MCL was 8μg/l, and maximum observed concentration was 36 μg/l. These groups will bear more medical costs and other socio-economic loss.
Extent to which threat is currently regulated	See policy and regulatory framework.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	H – byproduct of several industries, especially coal-fired power plants.
Small business industry	M - byproduct of different industries.
Transportation	L
Residential	M – contamination from household sources.
Agriculture	M - historical land-applied mercurial pesticides.
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	M - point sources such as landfills.
Diffuse Sources	

Sediment sinks	M – particularly with disturbance and redistribution of marine and estuarine sediments.
Soil sinks	M - long-term movement of watershed soil Hg (resulting from atmospheric deposition) into aquatic systems).
Non-local air sources incl. deposition	H – atmospheric deposition from regional sources.
Biota sinks	M – bioaccumulation
References	See data sources and reference listed in human health and ecological quality TWGs' reports. See also: http://www.state.nj.us/dep/dsr/mercury-698.doc http://www.state.nj.us/dep/dsr/mercusgs.pdf Joel Schwarz. "Societal benefits of reducing lead exposure." Environmental Research 66 (1994): 105-124.
Current Policy and Regulatory Framework	See other TWG writeups.
Federal	
State & Local	

Issue: Mercury
Author: Clinton Andrews
Version: 04/16/00

Mercury is a byproduct of several industries, including coal-fired plants. In addition, there is some mercury in the environment because of its historical use in pesticides. Mercury has entered aquatic environments through runoff. Mercury is a neurotoxin, and has been associated with birth defects. Mercury pollution imposes medical costs on the order of $2-113 million or more per year in NJ, plus psychological stress.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	2	0.1	2
Duration/ Irreversibility	1	1	2	1	1
Scale (spatial, population)	1	2	1	1	1
Subtotal Risk	1	2	4	0.1	2

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
1.82	**1.82**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	2	2	1	2	1.6

Trend: 0

Catastrophic Potential: L

Issue: Methyl Tertiary Butyl Ether
Author: John Posey
Version: 03/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Methyl Tertiary Butyl Ether (MTBE)**
Description of stressor	MTBE is a volatile organic compound derived from natural gas that is added to gasoline in many parts of the U.S. to increase the octane level and to reduce carbon monoxide and ozone levels in the air. Motorists are exposed to MTBE via inhalation while fueling their cars. In addition, the occupational exposure for gas station workers may be a threat. (However, the NJCRP Steering Committee has elected to exclude analysis of occupational exposure.) More seriously, MTBE has been found in dozens of wells in NJ, fueling fears that MTBE could contaminate the water supply. MTBE dissolves into water very quickly, and therefore spreads quickly through any water sources that it comes into contact with.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	In August, 2000, 94 residents of NJ filed a suit against Chevron and Gulf Oil Companies, claiming that MTBE from leaking fuel tanks gave them headaches, nausea and dizziness. In addition, EPA classifies MTBE as a possible human carcinogen. However, HHTWG considers the health risks associated with MTBE to be minimal, and reports that the symptoms listed in the lawsuit have not been linked to MTBE in any controlled exposures.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	MTBE has a bad odor and taste. Therefore, its presence in drinking water and in the air may be considered an aesthetic impact. There is evidence that many residents of NJ have some degree of worry concerning MTBE. This may be considered as a psychological impact. There is no evidence that MTBE has resulted in any significant medical costs in NJ.
Key impacts selected (critical socio-economic effects)	Psychological Impact, Aesthetic Impact.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Motorists are exposed to MTBE by inhalation when they fuel their vehicles. However, risk associated with MTBE in the air is minimal. Persons dependent on well water may ingest MTBE if these wells are located near leaking underground fuel tanks (LUFTs).
Quantification of exposure levels statewide	A 2000 report by the U.S. Geological Service (USGS) found that more than 400 public drinking water wells in NJ are within 1000 meters of a leaking underground storage tank. However, this does not indicate that each of these wells has been contaminated. First, not all underground storage tanks are used to store fuel. Second, not all fuel tanks store gasoline containing MBTE. Third, not all leaks from underground tanks actually reach drinking water. Still, the report was widely interpreted as indicating that there is significant risk from MTBE poisoning in NJ. In 1999, the Office of the Governor reported that 73 wells in NJ had been found to contain MTBE. However, in almost every case, the level was far below the 70 ppb health threshold established by the DEP.
Specific socio-economic entities at increased risk	Communities relying on well water. In addition, there is some indication that individuals who are sensitive to MTBE may suffer minor respiratory problems when MTBE is inhaled. Unfortunately, there is no estimate of the number of persons deemed sensitive to the substance. However, the number is believed to be small.

Quantification of exposure levels to entities at increased risk	I will assume that communities relying on well water face 100% of the risk.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Qualitative assessment of aesthetic and psychological impacts.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	a) Severity: It is possible that widespread concern about MTBE could reduce property values in communities dependent on well water. Thus far, however, there is no evidence that this has occurred.	1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1
Employment	a) Severity: No impacts hypothesized	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1
Costs Incurred	a) Severity: It is possible that MTBE contamination could cause illnesses, and that this could impose medical costs. However, there is no evidence that this has occurred. HHTWG concludes that reports of illnesses linked to MTBE are anecdotal, and have not been medically substantiated. Thus, there are no demonstrable medical costs to date.	1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1
Aesthetic Levels	a) Severity: MTBE has a bad odor and a bad taste. The taste and smell thresholds may go as low as 20 ppb, which is much lower than the 70 ppb health threshold established by the state. Thus, the presence of MTBE may create an aesthetic impact, even when there is no demonstrable health impact. In addition, the smell of MTBE is detectable in and around filling stations. Although there is little demonstrable health risk to motorists, this may also be considered an aesthetic impact. The presence of aesthetic impacts to both water and air make it not unreasonable to conclude that MTBE has a moderate aesthetic impact.	2
	b) Duration/irreversibility: Air exposure lasts only as long as a motorist is in the gas station. Persons who taste MTBE in drinking water may be able to substitute other drinking water sources. In addition, there are technologies for removing MTBE from water, including air stripping and oxidation processes. However, MTBE is more difficult to remove than other chemicals, and doing so may be costly.	1

	c) Scale: Pollution around gas stations is highly localized. The number of wells afflicted with MTBE contamination in portions greater than 20 ppb is thus far very small. Thus, it appears that MTBE aesthetic impacts have thus far had a very limited scale.	1
	d) Uncertainty: These conclusions are fairly speculative.	3
Psychological Impacts	a) Severity: There is some evidence that the public is concerned about the presence of MTBE in drinking water. First, a lawsuit has been filed by residents who claim that low-grade illnesses have been caused by the presence of MTBE. Second, some 15,000 citizens of NJ signed a petition calling for a ban on the use of MTBE. Third, a 60 Minutes report on MTBE in NJ drinking water created a public furor in January, 2000, according to news reports. Thus, it seems reasonable to conclude that there is a moderate amount of worry surrounding the use of MTBE.	2
	b) Duration/irreversibility: Since federal and state governments are moving toward a phase out of the use of MTBE, this problem will be of limited duration.	1
	c) Scale: Although worry can affect many more people than are actually affected by the problem, intense worry is likely confined to those drinking well water or enduring occupational exposures.	1
	d) Uncertainty: I am fairly confident that these conclusions are reasonable.	2
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	++ It appears that MTBE will be phased out over the next few years.	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	Communities relying on well water are at greatest risk.	
Extent to which threat is currently regulated	See federal and state regulations, below.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		

NJ Primary Sources	
Large business/industry	H: MTBE is added by refineries
Small business industry	H: MTBE can leak from gas station underground tanks.
Transportation	M: Motorists are exposed to MTBE while fueling their vehicles.
Residential	L
Agriculture	L
Recreation	M: Jet skis and powerboats can deposit MTBE into lakes and streams.
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	M: Abandoned sites containing leaking underground fuel tanks may contribute to the problem.
Diffuse Sources	
Sediment sinks	L
Soil sinks	H: MTBE may enter ground water supplies when released into the soil from a leaking underground tank.
Non-local air sources incl. Deposition	L
Biota sinks	L
References	Associated Press. "Gasoline Additive Said to Taint Water." *Northern New Jersey Record*, 2/21/2000. Jim Barker. "MTBE: A Gasoline Additive Caught in an Environmental Debate." University of Waterloo. www.science.uwaterloo.ca/earth/waton/mtbe.html John Bidgood. "Remedies Available for Tainted Water." *Northern New Jersey Record*, 2/24/2000. John Elston. Testimony before the NJ Assembly Environment Committee, March 20, 2000. Michael Gormley. "Pataki Bans Gasoline Additive." *Northern New Jersey Record*, 5/25/2000. H. Josef Hebert. "Northeast States Seek More Power to Limit Gas Additive." *Northern New Jersey Record*, 1/20/2000.

	Richard Johnson et al. "MTBE: To What Extent Will Past Releases Contaminate Community Water Supply Wells?" *Environmental Science and Technology*, May 1, 2000. James McCarthy and Mary Tiemann. "MTBE in Gasoline: Clean Air and Drinking Water Issues." Congressional Research Service, Report for Congress. July 7, 1998. NJDEP, Office of Air Quality Management. "Control and Prohibition of Air Pollution by Vehicular Fuels." *New Jersey Register*, July 21, 1997. NJ Office of the Governor. "Press Release: Governor Whitman and DEP Welcome End of Wintertime Oxygenated Fuel Program." June 24, 1999. www.state.nj.us/dep/newsrel/releases/99_0084.htm Jeff Pillets. "EPA Plans to Outlaw Feared Gasoline Additive; Cites MTBE Dangers to Ground Water." *Northern New Jersey Record*, 3/21/2000. Anthony Twyman. "Shore Residents Sue Over MTBE Pollution." *Newark Star Ledger*, 8/26/2000. U.S. Department of Energy, Alternative Fuels Data Center. "P-Series General Information." www.afdc.nrel.gov/altfuel/pse_general.html U.S. EPA. "Methyl Tertiary Butyl Ether (MTBE): Underground Storage Tanks." June 21, 2000. www.epa.gov/mtbe/storage.htm U.S. Geological Survey. "Occurrence of the Gasoline Additive MTBE in Shallow Ground Water in Urban and Agricultural Areas." 1995. http://sd.water.usgs.gov/nawqa/pubs/factsheet/fs114.95/fact.html U.S. Geological Survey. "Selected Community Water Supply (CWS) Wells and Leaking Underground Storage Tanks (LUSTs), New Jersey. http://sd.water.usgs.gov/nawqa/pubs/journal/est-mtbe1/statedata/nj.htm
Current Policy and Regulatory Framework	
Federal	Under the Clean Air Act of 1990, numerous areas with poor air quality are required to add chemicals called "oxygenates" to gasoline as a means of improving combustion, thereby reducing emissions. The most commonly used of these oxygenates, especially in the northeast, is MTBE. Nationally, 87% of Re-Formulated Gas (RFG) contains MTBE. However, a few regions in the west and Midwest choose to rely on ethanol. Under a 1992 EPA RFG regulation, all gasoline sold in NJ contains MTBE in the amount of 11% of volume, or 2% of total weight. Under a 1995 regulation, wintertime levels in certain northern counties increased the proportion of MTBE to 15% of volume (2.7% of weight). In June, 1999, EPA ended the wintertime requirement, and gasoline sold in NJ now contains 11% MTBE year-round. In testimony before the NJ Assembly Environment Committee, DEP has expressed the opinion that MTBE has significantly reduced both carbon monoxide, benzene (a carcinogen), and hydrocarbons, which are major contributors to ozone. The Congressional Research Service also reports that MTBE has reduced the cancer risk associated with tailpipe emissions by 30 to 40% by reducing benzene levels. In March, 2000, the EPA urged Congress to ban the use of MTBE after the year 2003. EPA was responding to concerns over drinking water from numerous states, including NJ. A blue-ribbon panel had studied the effects of MTBE. It concluded that current levels of MTBE do not pose a threat to human health, but that MTBE should be phased out in order to preclude a potential environmental problem.

	NJ officials welcomed the policy change. However, the head of the DEP Air Quality division has noted that some other oxygenate will have to be substituted for MTBE. The most commonly used alternative is ethanol. The economic impact of a shift from MTBE to ethanol will be mixed for NJ. NJ Farm bureau officials have speculated that a shift to ethanol will benefit NJ corn farmers, and are studying the idea of building an ethanol plant in South Jersey. On the other hand, ethanol costs 10 to 15% more than MTBE, so motorists may be forced to pay higher prices. There is no way to predict in advance whether the overall economic impact will be positive or negative. In addition, ethanol presents some environmental problems of its own. Ethanol, when added to gasoline, increases the evaporation of gasoline. Evaporation contributes to the level of hydrocarbons in the atmosphere, which can contribute to smog. This is an especially great problem for older cars. In older cars, the rate of evaporation is great enough that a car in a garage can produce enough fumes to affect air quality inside of a house. DEP officials have expressed concern that evaporative emissions, especially in summer, may be as serious of a problem as tailpipe emissions. Thus, ethanol is no panacea, and may produce a new set of environmental problems. A promising potential replacement for MTBE is the P-Series Fuel produced by the Pure Energy Corporation of Princeton, NJ. P-Series is now classified as an alternative fuel, and may be mixed with gasoline in any proportion. P-Series fuel is a blend of ethanol, methyltetrahydrofuran (MTHF), and pentanes. P-Series Fuel is designed to be environmentally friendly, and Pure Energy reports that it produces far fewer hydrocarbons and other pollutants than gasoline. MTHF is made from cellulosic stock, a major component of household garbage. P-Series fuel contains 60% MTHF. Since a NJ corporation holds exclusive rights to the production of P-Series fuel, the switch to this alternative additive could produce significant economic benefits to the NJ economy. More research is needed on the potential for substituting P-Series for MTBE.
State & Local	In 1996, after discovering MTBE in both public and private wells, NJ became one of the few states to set drinking water standards for MTBE. The level established by DEP is 70 parts per billion. In addition, NJ has a well-funded tank removal program that is currently detecting and treating contaminated groundwater. In January, 2000, NJ joined seven other northeast states in asking the EPA to grant them greater authority to regulate MTBE. MTBE has been banned in the state of NY.

Issue: Methyl Tertiary Butyl Ether
Author: John Posey
Version: 03/01

MTBE is a fuel additive. Refineries add the chemical to gasoline in order to reduce carbon monoxide emissions and to boost octane. In recent years, there have been anecdotal reports of minor sicknesses being caused by MTBE. Although there have been a few complaints about headaches and dizziness resulting from the inhalation of MTBE, the more serious threat is the possible contamination of ground water. MTBE dissolves very easily, and therefore travels quickly through water supplies or moist soil. Thus, wells located near leaking underground fuel tanks (LUFTs) are susceptible to MTBE contamination. MTBE has been found in dozens of wells in NJ, although there are very few instances in which the concentration came within an order of magnitude of the state safety threshold. Thus far, there have been few documented cases of illness due to MTBE. However, there does appear to be significant public concern about MTBE, and this concern is not entirely irrational. Thus, MTBE may be considered to have a moderate psychological impact. Moreover, with its bad taste and odor, MTBE in either air or water may be considered a moderate aesthetic impact. Because of federal and state action, the use of MTBE is being phased out.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	0.1	1	2	2
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	0.1	1	2	2

Average Risk (0 – 5 years)	Average Risk (5 years plus)
1.22	1.22

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	3	2	1.6

Trend: ++

Catastrophic Potential: L

Issue: Nickel
Author: John Posey
Version: 04/03/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	Findings/Notes
Hazard Identification	
Stressor	**Nickel**
Description of stressor	Nickel is a silvery metal which is abundant in nature. The manufacture of stainless steel accounts for 60-75% of worldwide nickel use according to the Human Health Technical Work Group (HHTWG).
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Nickel can pose a threat to human health in three ways: First, inhalation of nickel dust or fumes can be carcinogenic. Second, high levels of nickel in drinking water can be dangerous. Third, exposure to nickel can cause minor skin irritation.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	HHTWG considers inhalation to be the only noteworthy nickel threat in NJ. HHTWG finds that nickel levels in drinking water are within safe levels, and skin irritation is a minor threat to a very small group of nickel-sensitive individuals. Thus, this write-up deals only with the costs of cancers associated with atmospheric nickel.
Key impacts selected (critical socio-economic effects)	Costs incurred.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Atmospheric nickel exists in very low amounts throughout the state.
Quantification of exposure levels statewide	HHTWG reports ambient level of 0.00048 mg/m^3.
Specific socio-economic entities at increased risk	None reported.
Quantification of exposure levels to entities at increased risk	Same as statewide.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	Review of cost-of-illness literature on cancer.

Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: None hypothesized.	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Employment	Severity: None hypothesized.	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Costs Incurred	Severity: HHTWG reports that levels of ambient atmospheric nickel will lead to approximately 5.1 cancer cases per million persons over a lifetime. Since there are approximately 8 million people in NJ, this works out to approximately 40 cancer cases over a lifetime. If an average lifetime is 70 years, then we might expect a case of nickel-related cancer every other year. NIH estimates indicate that an average case of cancer imposes economic costs of about $60,000 (see write-up on 1,3-Butadiene for more on this calculation). Thus, the average annual cost to the NJ economy is probably less than $30,000. NJCRP guidelines call for a score of "1" to be given to all impacts less than $16 million.	*1*
	Duration/irreversibility	1
	Scale: Statewide	3
	Uncertainty: There is little reason to believe that nickel-induced cancers cost the state more than $16 million per year.	1
Aesthetic Levels	Severity: None hypothesized	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Psychological Impacts	Severity: There is little evidence that the public is aware of, or alarmed about, the risk of nickel poisoning.	*0.1*
	Duration/irreversibility:	1
	Scale:	3
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L: HHTWG indicates that cancer risks may be overstated.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, ---	0. HHTWG believes that the possibility of future changes is low.	

where + is improvement), and brief description	
Potential for catastrophic impacts (H,M,L) and brief description	L
Incidence of impacts (affected sub-groups, variability, equity issues)	None reported.
Extent to which threat is currently regulated	HHTWG reports that the safe drinking water level has been set at 1 mg/l. OSHA has set the following maximum levels for workplace atmospheric exposure: Metal and insoluble nickel – 1 mg/m3 Soluble inorganic nickel – 0.1 mg/m3 Nickel Carbonyl - 0.007 mg/m3
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	M
Small business industry	M
Transportation	L
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	M
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	M: Nickel binds to sediment.

Soil sinks	M: Nickel occurs naturally in soil.
Non-local air sources incl. deposition	M.
Biota sinks	L
References	National Institutes of Health. Disease-Specific Estimates of Direct and Indirect Costs of Illness and NIH Support. 1997. U.S. Census Bureau. State Population Estimates, 6/1/99. American Cancer Association. Statistics. www.cancer.org/statistics
Current Policy and Regulatory Framework	See "Regulation," above.
Federal	

Issue: Nickel
Author: John Posey
Version: 04/03/00
Nickel is a naturally occurring metal. Most industrial uses of nickel involve the production of stainless steel. Inhalation of atmospheric nickel may be carcinogenic. HHTWG estimates that approximately 40 cases of cancer in NJ may be attributable to atmospheric nickel. The economic cost of these illnesses is approximately $3 million.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	3	0.3	0.3

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.84	0.84

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: L

Issue: Nitrogen Pollution
Author: John Posey
Version: 11/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework **Findings/Notes**

Hazard Identification	
Stressor	**Nitrogen Pollution**
Description of stressor	Nitrogen and nitrates can enter water supplies and aquatic ecosystems in four ways: 1) There is a natural supply of nitrates in soil and water. 2) Agricultural runoff (including livestock manure and fertilizers) contributes to the problem. 3) Wastewater is rich in nitrogen and nitrates; septic systems contribute to the problem. 4) Atmospheric deposition can contribute. This writeup focuses on the first three, as atmospheric depositions are covered in separate writeups on acids and irritative gases, and on N0x.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Human Health Impacts: The Human Health Technical Work Group (HHTWG) declined to produce a writeup on this issue, an indication that human health risks are minimal. However, it should be noted that nitrates in drinking water have been associated with several types of illnesses. First, a rare condition known as "blue baby syndrome" can result from excess nitrates in drinking water. Second, there have been suggestions of links between nitrates in drinking water and cancer. The National Cancer Institute reports an association between nitrates and non-Hodgkin's lymphoma, particularly in agricultural areas of the United States, and researchers at the University of Iowa have found an apparent link between nitrate levels and bladder cancer. Third, according to a report issued by the Environmental Working Group (EWG), a 1994 Danish study "found that individuals drinking water with a high nitrate content exhibited a dose related increase in hypertrophy, a condition marked by enlargement of the thyroid…." Fourth, also as reported by EWG, there is some evidence of a link between nitrates and birth defects: "At least five studies have indicated a possible link between exposure to nitrite, nitrate and N-Nitroso compounds and birth defects. The effects of exposure were first observed in animal studies, but have since been observed in human epidemiological studies". Ecological Impacts: According to the Ecological Quality Technical Work Group (EQTWG), "Ammonium (NH_4^+) can be toxic to fish, and the natural conversion of ammonia to nitrate (NO_3^-) can result in oxygen depletion in aquatic ecosystems. Excess nitrogen in water (NO_3^-, DON, and NH_4^+) can contribute to eutrophication, especially in estuaries and coastal waters. NOx , DON and NH_4^+ contribute to regional air pollution and to acid precipitation, and deposited NOx , DON, and NH_4^+ contribute significant amounts of nitrogen to both aquatic and terrestrial ecosystems. Ecosystem disruption can result from uneven species responses to nitrogen fertilization across species (Vitousek, 1999). Nitrous oxide (N_2O) in the atmosphere contributes to the greenhouse effect and to the destruction of stratospheric ozone."
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	1) It is possible that nitrates in drinking water may impose medical costs. However, the Human Health Technical Work Group (HHTWG) has declined to produce a writeup on this topic, an indication that nitrates in drinking water probably pose minimal health risks in NJ. This writeup therefore does not address this potential impact. 2) Saltwater eutrophication may lead to harmful algal blooms, which may threaten some jobs related to beach tourism. However, the impact of harmful algal blooms in saltwater ecosystems has been addressed in separate writeups. Therefore, this writeup will not cover this topic. 3) In certain cases, excess nitrogen levels can lead to freshwater eutrophication. This is the case in Lake Tahoe, and certain lakes in Florida. Normally, however, phosphorus is the eutrophying agent in freshwater systems. In its writeup on Nitrogen, EQTWG lists saltwater eutrophication as a key impact, but does not list freshwater eutrophication. 4) Removing nitrates from drinking water supplies can be costly, as inexpensive filtering techniques cannot remove nitrates from water. However, NJCRP guidelines specify that

	routine and ongoing remediation costs are not to be considered in SETWG writeups, and hence will not be discussed here. 5) Ammonia toxicity may threaten jobs relating to freshwater recreational fishing. This is the main potential impact that will be discussed in this writeup.
Key impacts selected (critical socio-economic effects)	Employment
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Ammonia toxicity can affect all fish species, but trout are particularly susceptible. This holds the potential to threaten tourism jobs related to freshwater fishing.
Quantification of exposure levels statewide	For freshwater ecosystems, the freshwater criteria established by the EPA are 20 ppm for trout waters, and 50 ppm for non-trout waters. According to EQTWG: "Typical inorganic nitrogen levels in New Jersey rivers and streams range from less than 1 ppm to 3 ppm or higher. Areas with especially high nitrate concentrations include South River in the Lower Raritan Watershed (WMA 9), which in 1996 had one sample exceeding 10 ppm (NJ DEP 1999). Typical inorganic nitrogen levels in New Jersey coastal waters are in the range of 0.4 to 0.6 ppm. Typical DON levels in New Jersey coastal waters are in the range of 0.3 to 0.7 ppm (Seitzinger, 2000)".
Specific socio-economic entities at increased risk	Jobs related to trout fishing are concentrated in Sussex County.
Quantification of exposure levels to entities at increased risk	According to EQTWG: The only exceedances of ammonia criterion in 1996 were in the Upper Delaware watershed (WMA 1), where 3 out of 23 samples at Musconnetcong exceeded 20 ppm, and in the Raritan watershed (WMA 8), where one sample in trout waters contained 85 ppm ammonia. In the Lower Passaic River Basin (WMA 4), a non-trout watershed, ammonia levels are high (median of 12 ppm, maximum of 40 ppm) but within the non-trout criterion of 50 ppm.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	
Risk Characterization	

Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: No impacts hypothesized.	*.1*
	Duration/irreversibility	1
	Scale	1

	Confidence	1
Employment	a) Severity: It is unlikely that any adverse impacts on trout and other fish have yet been translated into job loss. EQTWG reports that 90% of trout streams are within acceptable ammonia limits, and that affected areas continue to have functioning ecosystems, despite the possible diminution of trout abundance. A Lexis-Nexis search of NJ news sources failed to reveal any trout kills in the last 15 years attributable to excess nitrogen/ammonia levels. Here is a rough calculation of the potential impact of trout reductions in Sussex County. If 10% of the streams are affected by ammonia, and if this results in a loss of 50% of the trout in these streams (a pessimistic assumption), then this would result in a loss of 5% of the trout population. I will assume that this will result in a 5% loss in trout-related trade and tourism, and therefore a 5% reduction in trout-related jobs. In Sussex County in 1997, there were a total of 3,632 jobs in the following industries: Lodging, restaurants, amusement & recreation, and auto service. If we assume that half of the business in these industries was generated by trout fishermen (which is probably an overestimate), then a 5% loss in these industries would result in a loss of about 90 jobs, or less than one half of one percent of all jobs in the county (total employment=27,100). This is considered a low impact under NJCRP guidelines. As noted above, this probably actually overstates the actual impact on employment. It should be noted that although trout are particularly susceptible to ammonia (as indicated by differential ammonia criteria for trout vs. non-trout waters), ammonia exhibits some degree of toxicity in most fish species. Thus, there may be some level of non-trout fish mortality due to ammonia. However, it is highly unlikely that these extra fish, if counted, would significantly impact the economic impact assessment of ammonia toxicity. First, as noted above, ammonia criteria are rarely exceeded in NJ. Second, as noted above, there are relatively few jobs in NJ that depend on freshwater fishing. NJCRP guidelines require a job loss of more than 20,000 in order to warrant a "moderate" impact rating. By this criterion, it is scarcely conceivable that ammonia toxicity could be reckoned to have even a moderate employment impact.	*1*
	Duration/irreversibility	1
	Scale	1
	Confidence	1
Costs Incurred	Severity: Aside from the aesthetic impacts of harmful algal blooms addressed in other writeups, no impacts are hypothesized.	*.1*
	Duration/irreversibility	1
	Scale	1
	Confidence	1
Aesthetic Levels	Severity: NO impacts hypothesized	*.1*
	Duration/irreversibility	1
	Scale	1
	Confidence	1

Psychological Impacts	Severity:	*.1*
	Duration/irreversibility:	1
	Scale:	1
	Confidence	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: There are several basic research needs. The EQTWG report surveys drinking water nitrate standards around the world, and suggests that the EPA level of 10 mg per liter is too high. Additional information on this topic might increase the assessment of health risk. Similarly, additional epidemiological information about links to cancer and birth defects could increase the estimate of costs associated with nitrates. In addition, publicly available information on the number of NJ wells that exceed the 10 mg per liter limit in a given year would help to refine estimates of possible health costs.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0 (according to EQTWG)	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	NA	
Extent to which threat is currently regulated	See "regulation," below.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	L	
Small business industry	L	
Transportation	L	
Residential	H: Lawn, garden and septic runoff	
Agriculture	H: Agricultural runoff	

Recreation	M: Golf courses
Resource extraction	L
Government	M: Wastewater Plants
Natural sources/processes	H
Orphan contaminated sites	M
Diffuse Sources	
Sediment sinks	M
Soil sinks	M
Non-local air sources incl. Deposition	H
Biota sinks	L
References	D. Anderson, P. Hoagland, Y. Kaoru, and Alan White. "Estimated Annual Economic Impacts Resulting from Harmful Algal Blooms (HABs) in the United States." Woods Hole Oceanographic Institution Draft Technical Report. August, 2000. Associated Press. DiFrancesco Signs Well Testing Measure into Law. 3/23/01. Fred H. Bowers. "Septic Systems and Nitrate Nitrogen as Indicators of Ground Water Quality in New Jersey." New Jersey Department of Environmental Protection, Division of Water Quality. www.state.nj.us/dep/dwq/pdf/nitrates.pdf Environmental News Network. Nitrate in Drinking Water Causes Bladder Cancer. 2001. www.enn.com Environmental Working Group. Pouring It On: Nitrate Contamination of Drinking Water. 1996. www.ewg.org/pub/home/reports/Nitrate/ Terry D. Garcia, Assistant Secretary of Commerce for NOAA. Testimony before the U.S. Senate Subcommittee on Oceans and Fisheries Committee on Commerce, Science and Transportation, 5/20/98. Mary Downes Gastrich. "Harmful Algal Blooms in Coastal Waters of New Jersey." NJ DEP, 5/20/00. NOAA. National Harmful Algal Bloom Assessment. 10/22/99. Lynda Knobeloch et al. Blue Babies and Nitrate Contaminated Well Water. *Environmental Health Perspectives* 108(7), July 2000. National Cancer Institute. Nitrate in Drinking Water Associated with Increased Risk for Non-Hodgkin's Lymphoma. 9/13/96. http://cis.nci.nih.gov/fact/3_55.htm NJ Department of Environmental Protection (DEP), Bureau of Marine Water Monitoring. Annual Summary of Phytoplankton Blooms and Related

	Conditions in New Jersey Coastal Waters Summer of 1999. J.R. Self and R.M. Waskom. "Nitrates in Drinking Water." Colorado State University Cooperative Extension. www.cdc.gov/niosh/nasd/docs/as27700.html US EPA, Office of Water. Ammonia Toxicity: An Overview, Appendix F in *Inland Testing Manual.* www.epa.gov/ostwater/itm/ITM Washington State Department of Health. "Nitrates in Drinking Water: Position Paper." WHOI. "U.S. Finfish, Shellfish and Wildlife Affected by Toxic or Harmful Microalgal Species." Http://www.redtide.whoi.edu/hab/species/speciestable.html Janice Woodard et al. Nitrates in Household Water. October, 1996. www.cdc.gov/niosh/nasd/docs4/va98086.html
Current Policy and Regulatory Framework	
Federal	EPA has established a drinking water standard of 10 mg per liter. EPA has also established freshwater ammonia criteria of 20 ppm for trout waters, and 50 ppm for non-trout waters.
State & Local	A law signed by Acting Governor DiFrancesco in March, 2001 requires the testing of private wells for nitrates (and other chemicals) as a condition of a real estate sale. In situations where tenants are leasing properties, the wells will have to be tested every five years. The law also appropriates $1 million, which would be used to allow the state Department of Environmental Protection to establish a well water database. Fertilizer runoff is not regulated, nor is nitrate loading from domestic septic systems. Large flow onsite sewage disposal systems such as strip malls, schools and small businesses located in areas not served by public sewers must comply with NJPDES permits issued by NJDEP.

Issue: Nitrogen Pollution
Author: John Posey
Version: 11/00

Issue description: In the form of ammonia, nitrogen can diminish freshwater trout populations. About 10% of the state's trout streams may be affected by this problem, though the affected ecosystems continue to function. To date, the economic impacts of trout loss have been minimal. Nitrogen also contributes to eutrophication in saltwater ecosystems. This can lead to harmful algal blooms. This issue was already addressed in a separate writeup, which concluded that it is difficult to demonstrate that HABs have had significant economic impacts thus far. Medical problems associated with nitrates in drinking water include a condition known as "blue baby syndrome," bladder cancer, non-Hodgkin's lymphoma, thyroid dysfunction and birth defects. However, HHTWG declined to produce a writeup on this issue, an indication that health-related costs in NJ are probably minimal.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2) and Low (1). Subtotal Risk = multiplicative product of the three factors; Average Risk is the average of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	.1	1	.1	.1	.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	.1	1	.1	.1	.1

Average Risk (0 – 5 years)
0.28

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Confidence**
Confidence Level	1	1	1	1	1	1

Long-term socioeconomic impact estimate:

Average Risk (5 years plus)
0.28

Trend: 0
Catastrophic Potential: L

Issue: Noise Pollutioni
Author: John Posey
Version: 04/03/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework **Findings/Notes**

Hazard Identification		Data Sources
Stressor	**Noise Pollution** Impacts considered: Noise related to major transportation infrastructure: airports, highways, and railroads Noise emitted by recreational vehicles (jet skis, all terrain vehicles, snow mobiles) Impacts not considered are: Residential noise from snow-blowers, leaf blowers, etc. These are generally regulated by municipal noise ordinances in New Jersey. Work-related noise. This is regulated by OSHA. Construction-related noise. This is episodic and regulated by the state. Note: The assessment of the impacts of noise on human health similarly excluded from consideration a number of sources of ambient noise associated with daily life, such as workplace noise, personally-controlled noise (e.g., radios), and noise from mini-environments, such as the interior of a house. The human health assessment excluded these impacts because they are subject to a high degree of personal control.	
Description of stressor	Noise impacts are typically described in terms of loudness, measured in decibels, and duration. It is considered to be "noise pollution" when the loudness rises above background levels (around 40 to 50 decibels) for a sustained period of time. A 10 to 15 db increase over background is often considered "substantial." Similarly, HUD guidelines (24CFR51) uses 65 db as the noise threshold at which mitigation is required. For comparison, some noise levels discussed here are: quiet residential area (40db), freeway traffic (70db), heavy traffic (85db) snowmobile (100db), lawn mowers and leaf blowers (65-100db), jet taking off (150db).	League for the Hard of Hearing: www.lhh.org/noise/decibel.htm
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Ecological: Risks considered by the Ecological Technical Working Group were: 1) the impact of underwater noise on marine mammals; and 2) the impact of jet ski noise on nesting birds. The impact of underwater noise on marine mammals was regarded as having a minor, if any, socio-economic impact (perhaps only on whale-watching businesses) while the impacts of jet skis were considered in terms of the aesthetic impacts on recreational visitors. Both kinds of risk estimates were considered highly uncertain by the ecological technical working group. Human Health: Human health impacts from excessive noise may include hearing	Ecological TWG Stressor-Specific Risk Assessment for Noise League for the Hard of Hearing:

	loss (from continued exposure to noise over 85db or acute exposure over 140db). Impacts also include stress, anxiety, high blood pressure, sleep loss, distraction, and lost productivity. The human health write-up on noise did not consider the most common sources of hearing loss (other than old age) because they are sources over which people have a large amount of control (e.g., listening to loud music). Rather, the human health assessment focused on individuals with medical conditions, etc. that put them at increased risk from less voluntary sources of noise (such as the transportation noise considered here). Because the direct health-related costs on society from these sub-groups are not thought to be large, and because the subgroups are specifically highlighted below, direct costs are not considered as part of this socio-economic assessment.	www.lhh.org/noise/health.htm
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values. Impacts of noise from major transportation infrastructure on house values. Employment: No impacts considered. Damage cost: No impacts considered (see justification above). Aesthetics: Impacts of recreational vehicle use on visitors to New Jersey's recreational areas. (Note: aesthetics impacts from transportation noise were thought to be subsumed within the property values assessment). Worry. Impacts of noise from major transportation infrastructure on sense of well being of nearby populations.	
Key impacts selected (critical socio-economic effects)	Property values, Aesthetics, Worry	
Exposure Assessment		
Socio-economic entities exposure routes and pathways considered	Considered impacts to housing values and sense of well-being (worry) for populations impacted by transportation noise from: a) the NY/NJ air transportation hub of JFK, LaGuardia, Newark, and Teterboro airports; b) major state and interstate highways of New Jersey; and c) major rail corridors in New Jersey. Note: selecting these exposed populations likely underestimates risk because it does not include impacts from the 60 or so smaller airports in the state nor smaller state highways, roadways, and railways. Considered aesthetics impacts to recreational visitors to the New Jersey shore, Delaware Water Gap and other recreation areas throughout the state.	
Quantification of exposure levels statewide	Spatial: Noise impacts are localized around major sources of transportation noise and around recreational areas impacts by recreational vehicle noise. Generally, noise from highways and railways is thought to only be significant out to around 500 feet on either side of the source. Decibel levels for various sources are listed above. Temporal: Transportation noise does not have much seasonal variability. Noise from recreational vehicles generally occurs during the day and during the season associated with various forms of recreation (e.g., snow mobiles in winter and jet skis in summer).	

Specific socio-economic entities at increased risk	From the socio-economic perspective of impacts on housing cost, aesthetics, and worry, people at increased risk include those living very close to airports, highways, and rail lines and are exposed to the highest level of noise. These populations may be low-income because of reduced property values around such facilities. The human health write-up identified a number of entities at increased risk due to medical conditions. Because we are not considering direct medical costs, we do not break the population down in this way. Susceptibility to noise-related health impacts would have little impact on housing costs and aesthetics. It may have some impact on worry, but in ways that are not readily identifiable.		
Quantification of exposure levels to entities at increased risk	Included in state-wide risk estimates.		
Dose/Impact-Response Assessment			
Quantitative/Qualitative impact-assessment employed	Decreases in property values, increases in worry, and increases in aesthetic impacts are all thought to rise with increased exposure to noise. Most analyses seem to assume a linear relationship. There do not seem to be any threshold effects.		
Risk Characterization			
Risk estimate(s) by socio-economic entities at risk Property Values—Considered for major transportation, not for recreational vehicle use.	Severity: Airports A 1999 study by the New Jersey Institute of Technology gave an "order of magnitude" estimate of the impact of excessive noise (above background) from the NY/NJ transportation hub on New Jersey housing values of $24.8 billion. This property value impact alone is sufficient to warrant a "high" impact rating under NJCRP guidelines. Highway and Railroad Studies of aviation noise typically put the impact of noise on housing prices as between 0.5% and 2% drop per decibel increase. Two studies of airport noise and housing values put the impact on housing prices as a 1% and 1.33% drop per decibel increase. This write-up assumes that these dose-response relationships can be extrapolated to noise from highways and railroads. The analysis looks at the impacts on property values along linear strips through the state because noise impacts are only significant for property within about 500 feet of the source. A "back of the envelope" calculation—see table at end—puts the drop in real estate values from highways and railways at between $120 million to $13 billion with a mid-range estimate in the neighborhood of $6 billion.	Score 3	New Jersey Institute of Technology (1999) . *Impact/Response data from:* 1) New Jersey Institute of Technology (1999) and 2) Morrison et. al. (1998) 3) FAA (1985) "Airplane Noise Effects" *Data on noise and distance from roadways:* www.nonoise.org/library/highway/traffic/traffic.htm

	These calculations are generally consistent with results reported by Wilhelmsson (2000), who conducted one of the first hedonic valuation studies that attempted to measure the effects of noise pollution on property values. Wilhelmsson found that a 1% increase in noise level between about 40 and 68 db resulted in a price reduction of 0.2%, while a 1% increase over the 68db threshold reduced property values by 0.3%. The implication is that a house subject to a traffic noise level of 72% will suffer a 30% reduction in value compared to a house subject to normal background levels of about 40db, all else being equal. Total combined impacts on housing values are around $25 to $38 billion. This amounts to about 5% to 7% of the total real estate value of New Jersey ($518 billion).		
	b) Irreversibility: Housing prices would likely reverse if noise impacts were removed or controlled. These major transportation facilities are unlikely to be removed, but various policies can control the noise. For example, New Jersey is second only to California in spending on noise barrier walls along highways.	1	
	c) Scale: Impacts localized around airports and highway/rail lines, but these can be relatively high population areas, certainly more than 1000 people (e.g., northern New Jersey).	2	
	d) Uncertainty: New Jersey-specific study and data used. However, authors of airport study cite estimate as "order of magnitude" only. Other estimates require extrapolation from airport study and various best guesses. Severity is likely to be underestimated because there are many more airports, roadways, and rail lines generating noise than considered here.	2	
Employment--not studied, impact assumed to be minimal.	Severity	*0.1*	
	Irreversibility	1	
	Scale	2	
	Uncertainty	1	
Costs Incurred—not studied, impact assumed to be minimal	Severity	*0.1*	
	Irreversibility	1	
	Scale	2	
	Uncertainty: some medical costs may have been overlooked.	2	
Aesthetic Levels—studied for recreational vehicles only. Although transportation noise does have aesthetic impacts, these are manifested in property value impacts (see above).	Severity: The sounds of jet skis and other recreational vehicles can probably be regarded as "moderately annoying" and can be avoided with little to moderate effort (i.e., choosing to recreate elsewhere). A survey of New Jersey residents regarding coastal recreation found that interviewees cited jet skis as the number one environmental problem (Burger, 1998).	*2*	

	Irreversibility: Impacts episodic and highly reversible if source is removed (e.g., banning jet skis).	1	
	Scale: Impacts localized in recreation areas, but these sources are distributed around the state.	2	
	Uncertainty: Moderate confidence	2	
Worry—studied for transportation-related noise only. Worry here deals with the loss of well-being directly associated with noise and also worry about events related to the source of the noise (plane crashes; chemical spills from trucks on highways, etc.).	Severity: Noise, from sources like airports, have been linked to stress, sleep disturbances, and work/school performance, all of which seem somewhat related to the concept of worry. A 1997 study by Bronzaft found that 70% of those living in flight paths of airplanes, for example, "reported that they were bothered by aircraft noise and that these noises interfered with daily activities." Referring to the scoring template for "worry," transportation noise would be regarded as familiar and arousing moderate worry.	*2*	Airport noise fact sheet: *www.lhh.org/noise/facts/airport.htm* *Reference to Bronzaft study:* www.lhh.org/noise/facts/health.htm
	Irreversibility: Worry from transportation noise is reversible when noise is removed or mitigated.	1	
	Scale: Worry is localized around noise sources, but these sources are distributed around the state.	2	
	Uncertainty: Moderate confidence	2	
Data Gaps for estimating socioeconomic impacts Highlight significant data needs	There are data gaps on exposure and the nature of effects. On the exposure side, there was little information on property value impacts along major surface transportation corridors (unlike airports and property values which are quite well studied). In general, there was little information on what kind of noise pollution people are exposed to over the course of their daily lives. On the effects side, there seemed to be only sketchy evidence about the impact of noise on mental and emotional health. Also, there was some suggestion that noise could affect learning and concentration in children, which would produce long-term socio-economic impacts but which is not well understood.		
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs) Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	L - As the Ecological write up indicates, greater air and road traffic are expected although quieter vehicles and urban planning interventions may mitigate this problem to some extent.		
Potential for catastrophic impacts (H,M,L) and brief description	Low. Hard to imagine what a catastrophic impact from noise would be.		
Incidence of impacts (affected sub-groups, variability, equity issues)	Noise impacts are very localized around airports, highways, railways, etc. Local impacts to housing prices can be dramatic. Environmental equity issues are relevant as transportation facilities either go into low income neighborhoods or low income populations move into these areas due to low real estate prices.		

Extent to which threat is currently regulated	Noise is currently regulated at the local, state, and national levels, although it does not seem to be a priority for environmental regulatory agencies.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	Low	
Small business industry	Low	
Transportation	High	
Residential	Low	
Agriculture	Low	
Recreation	Moderate (recreational vehicles)	
Resource extraction	Low	
Government	Low	
Natural resources	Low	
Orphan contaminated sites	Low	
Diffuse Sources		
Sediment sinks	Low	
Soil sinks	Low	
Non-local air sources incl. deposition	Low	
Biota sinks	Low	
References	Burger, J. 1998. "Attitudes about recreation, environmental problems, and estuarine health along the New Jersey shoreline, USA" Env. Mngt. 22: 869-876. Department of Environmental Protection website: www.state.nj.us/dep/enforcement/pcp/pcp-olem.htm FAA (1985) "Airplane Noise Effects." Can be found at: www.nonoise.org/library	

	League for the Hard of Hearing (various): www.lhh.org/noise Morrison, Steven A., Tara Watson, and Clifford Winston. "Fundamental Flaws of Social Regulation: The Case of Airplane Noise" AEI-Brookings Joint Center for Regulatory Studies Working Paper 98-2, September 1998. New Jersey Institute of Technology, "Strategies to Evaluate Aircraft Routing Plans" (January 28, 1999). www.njit.edu/Home/noise/chapter5.htm Noise Pollution Clearinghouse (various): www.nonoise.org Wilhelmsson, Mats (2000). The Impact of Traffic Noise on the Values of Single Family Houses. Journal of Environmental Planning and Management, 43(6), pp. 799-815.	
Current Policy and Regulatory Framework		
Federal	Railway, highway, and airport noise fall under federal regulations.	
State & Local	At the state level, the main noise legislation is the 1971 Noise Control Act. This act spells out a "Model Noise Control Ordinance" that can be adopted by municipalities, which are primarily responsible for regulating noise. Stationary commercial and industrial noise is regulated by a set of state regulations promulgated in 1974 under the 1971 Noise Control Act.	www.state.nj.us/dep/enforcement/pcp/pcp-olem.htm

Calculation of Impacts of highway and railway noise on Real Estate Values in New Jersey

Parameter	**Operator**	**Low Estimate**	**High Estimate**
Miles of relevant roadway and railway (Scaling up by 2X and 4X total length of NJ Turnpike, Garden State, and Atlantic City Expressway which are around 400 miles in total length)	X	800	1600
% of roadway and railway adjacent to residential areas (Best guess)	-	25%	50%
Number of miles with sound barriers (Federal Highway Administration "Highway Traffic Noise" at www.nonoise.org/library/highway/probresp.htm)	=	70	70
Linear miles exposed	X	**130**	**738**
Number of houses per mile (Best guess)	X	40	100
Average house value (Best guess)	=	$150,000	$250,000
Total value of housing exposed		**$780 million**	**$18.5 billion**
Rise in decibels (based on 70 to 85 db above the background of a quiet neighborhood of 40 db)	X	30	45
% loss in house value from rise in decibels (from various analyses of impacts of airplane noise)	=	.5%	1.5%

Total % loss in housing value		**15%**	**68%**
Total value loss= (total value of housing impacted) x (total % loss in housing value)		**$117 million**	**$12.6 billion**

Socio-economic Impact Evaluation of Environmental Issue

Noise Pollution: Highways, airports, railroads, and recreational activities emit noise that adversely impacts property values and aesthetics, while also imposing moderate psychological costs.

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Worry**
Severity	3	0.1	0.1	2	2
Irreversibility	1	1	1	1	1
Scale	2	2	2	2	2
Subtotal Risk	6	0.2	0.2	4	4

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
2.88	**2.88**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Worry**	**Average Uncertainty**
Uncertainty	2	1	1	2	2	2

Trend: +

Catastrophic Potential: L

Issue: Off-Road Vehicles
Author: John Posey
Version: 12/00

New Jersey Comparative Risk
Socio-economic TWG
Stressor-Specific Risk Assessment

Off-Road Vehicle (ORV)

The term Off-Road Vehicle (ORV) refers to motorized recreational vehicles such as All Terrain Vehicles (ATVs), snowmobiles, and jet skis. ORVs have generated considerable controversy in the year 2000. In Pennsylvania and Wisconsin, a debate has raged about whether ATVs should be allowed in state forests. In April, the National Park Service acted to ban most uses of snowmobiles in national parks. Also in April, the Noise Pollution Clearinghouse released a study on the environmental impact of jet skis.

ATVs: The CDC provides the following definition of ATVs: "All-terrain vehicle" means any off-highway vehicle fifty (50) inches (1270mm) or less in width, having a dry weight of six hundred (600) pounds (273 kg) or less, traveling on three (3) or more low-pressure tires, having a seat or saddle designed to be straddled by the operator and handlebars for steering control." ATVs are controversial because of safety issues, noise, and impact on the environment. Consumer safety is beyond the scope of this report. Noise pollution resulting from ATVs is covered in a separate writeup. This report deals only with other impacts on the environment.

The issues raised by ATVs have been showcased in the state of Pennsylvania this year. There are approximately 63,000 registered ATV users in Pennsylvania, and the growing popularity of ATVs has produced calls for more ATV trails in state forests. However, a survey of state foresters raised concerns about the impact of ATVs on the environment. The survey found that 85% of foresters rate the impact of ATVs as "moderate" to "severe." According to the survey, ATVs have caused a degradation of stream beds, wildflower beds, wetlands, and vernal ponds. The most common problem cited was erosion. An unlikely spokesman against ATVs emerged in the person of Dick Martin, an ATV salesman and trainer who became disillusioned with ATVs when he saw the damage that they caused. Martin argued that ATV use inherently involves spinning wheels and tearing up soil. The result, he argues, is soil erosion, habitat and vegetation loss, trout stream degradation and vernal pond disruption.

Concern about the impact of ATVs has also been raised in Wisconsin. In September, the U.S. Forest Service banned the use of ATVs in three areas of the Chequamegon National Forest. The action followed the destruction of wetlands in the park over the summer.

ATV use is illegal in all NJ state parks. To date, there has been no study of the effects of ATVs on the NJ environment, but an estimated 343,000 acres of state park, forest and wilderness land has been damaged; through the first nine months of 2002, over 1400 summonses were issued for illegal ORV use. Because of the growing popularity of ATVs, it is possible that pressures to expand ATV trails in NJ may grow. An October 2002 policy directive aimed to develop two new legal recreational areas for ORVs by 2005, avoiding locations in any existing state park or wildlife management area, or other sensitive environmental areas. Additional study on the impacts produced by increasing ATV use would help to resolve future disputes about ATV use in NJ.

Snowmobiles: In April, the U.S. Department of the Interior announced plans to seriously curtail the use of snowmobiles in national parks. Donald Barry, Assistant Secretary for Fish and Wildlife and Parks, said: "Snowmobiles are noisy antiquated machines that are no longer welcome in our national parks." The decision was based on findings regarding the impact of snowmobiles on noise level and air quality. The noise generated by snowmobiles degrades the aesthetic qualities enjoyed by persons pursuing non-motorized recreation. In addition, air pollution from snowmobiles was found to be harmful to plants and animals. A statement from the Department stated: "The study indicated that air quality in national parks is negatively impacted by snowmobile use. Air quality degradation, videotape evidence of negative impacts on the soundscape, wildlife and air resources of Yellowstone National Park, and the compilation of public comments" all led to the decision to crack down on snowmobile use.

A Congressional hearing in May gave dissenters an opportunity to criticize the Department of Interior. The hearing included a representative from the Wyoming Parks Department and two representatives of the snowmobile industry. The critics raised three central arguments: 1) The ruling will cause economic damage to communities that host snowmobilers, and to snowmobile dealers throughout the country. 2) Snowmobiles are becoming cleaner and quieter. 3) Snowmobiles, if used responsibly, can provide an opportunity for

individuals to enjoy nature without harming the environment. In June and July, amendments were offered in both houses of Congress to repeal the Department of Interior crackdown. Both efforts died in committee.

Snowmobiling is allowed in four NJ state parks or forests, all of which are in the Skylands region: High Point, Stokes, Wawayanda and Worthington.

As with the case of ATVs, there is too little evidence about the use and impact of snowmobiles in NJ to allow a full writeup. However, additional information would undoubtedly be helpful to policy makers in the future as they wrestle with the costs and benefits of snowmobiles.

Jet Skis: A report by the Noise Pollution Clearinghouse estimates that noise pollution from jet skis causes nearly $1 billion in damage nationally each year. The study found that jet ski noise is annoying enough to beach goers that they can drive away significant numbers of tourists. The owners of homes near beaches can also suffer property value loss because of the nuisance of jet ski noise, according to the report.

The report also found two other types of impacts associated with jet ski use. First, the report cites other research showing that a jet ski produces in two hours the same exhaust emissions as a 1998 automobile produces in 100,000 miles. Second, the report found that jet skis are harmful to aquatic environments, although the extent of damage was deemed unquantifiable at this time:

> Jet skis also wreak more damage to the marine environment than other powerboats. Their high speeds can be lethal to fish and marine mammals, and they discharge much of their fuel unburned into the water. These impacts are magnified when jet skis venture into coves and inlets where wildlife thrive, since toxic hydrocarbons become concentrated in the shallow waters. And of course, jet ski noise frightens shorebirds and other wildlife from the habitat, further disrupting shore ecosystems. None of these costs have been estimated, to our knowledge; nor do they lend themselves to the type of cost accounting that we have applied here to jet ski noise.

It should also be noted that the EQTWG writeup on noise pollution cited evidence that jet ski noise pollution is a top nuisance to NJ beach goers.

Conclusion: There is insufficient evidence to allow a full assessment of the socio-economic impacts of ORVs in NJ. Additional information is needed regarding the incidence of ORV use in NJ, and the impacts caused. Nationally, ORV use is becoming more popular, even as environmentalists are becoming more concerned about the effects of ORV use. It is likely that NJ policy makers will be called upon to balance the wishes of ORV users with the exigencies of sound environmental management. To this end, additional research on ORVs in NJ would be useful.

References:

"ATV Use Banned in Three Areas of National Forest." *Wisconsin State Journal*. September 20, 2000.

Fernando Garcia, Director of Public and Regulatory Affairs for Bombardier Recreational Products. Testimony before the U.S. House of Representatives, Committee on Resources, Subcommittee on National Parks and Public Lands. May 25, 2000.

Gary Hoagland. "The Hills Are Alive with the Sound of Motors." *Northern New Jersey Record*. September 24, 2000.

Charles Komanoff and Howard Shaw. "Drowning in Noise: Noise Costs of Jet Skis in America." Noise Pollution Clearinghouse. April, 2000.

Issue: Off-Road Vehicles
Author: John Posey
Version: 12/00

Ellen Lyon. "Local/State Foresters Detail ATV Troubles." *Harrisburg Patriot News*. October 1, 2000.

John M. Lyon, President of the Illinois Association of Snowmobile Clubs. Testimony before the U.S. House of Representatives, Committee on Small Business, Subcommittee on Tax, Finance and Exports. July 13, 2000.

"Proposed Legislation: All-Terrain Vehicle Regulation Act." Center for Disease Control. www.cdc.gov/niosh/nasd/docs4

Kim Rapp, Manager of the Wyoming State Trails Program. Testimony before the U.S. House of Representatives, Committee on Resources, Subcommittee on National Parks and Public Lands. May 25, 2000.

U.S. Department of the Interior. Press Release: "National Park Service Puts the Brakes on Escalating Snowmobile Use in the National Park System." April 27, 2000.

U. S. Department of the Interior. "House Floor Action on Interior 2001 Budget Request." June 16, 2000.

U. S. Department of the Interior. "Senate Floor Action on Interior 2001 Budget Request." July 18, 2000.

Issue: Off-Road Vehicles
Author: John Posey
Version: 12/00
Off Road Vehicles: The term "Off Road Vehicle" (ORV) refers to motorized recreational vehicles such as All Terrain Vehicles (ATVs), jet skis and snowmobiles. Nationally, ORVs have been growing in popularity. But there has also been a growing national concern over the environmental impact of ORVs. Noise from ORVs can disturb wildlife, and diminish the aesthetic qualities of nature areas for those pursuing non-motorized recreation. ORVs can also be harmful to air and water quality. Finally, ATVs tear up ground in the forests where they are used. This causes erosion and degradation of streams and wetlands. Policy makers in NJ will likely be forced to balance the wishes of ORV users with the exigencies of sound environmental management. Additional research on the use and impacts of ORV use in NJ would therefore be useful.

Currently there is little available evidence about ORV use and impacts in NJ. The lack of data is reflected in the low risk assessments on this page. However, it should be noted that uncertainty is high. The actual impact of ORVs may be much higher than the assessments given here.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	0.1	1	2	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	0.1	1	2	0.1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.84	0.84

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	3	3	3	2	3	2.8

Trend: --

Catastrophic Potential: L

Issue: Overharvesting (Marine)
Author: John Posey
Version: 01/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Overharvesting (Marine)**
Description of stressor	Depletion of marine resources due to unsustainable level of harvesting.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Overharvesting poses threats to biodiversity and ecological integrity. It can lead directly to the decimation of individual species, and indirectly to the damage of entire ecosystems.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Overharvesting can threaten employment in the fishing industry. In addition, migratory birds that roost at Cape May depend on crabs. To the extent that the overharvesting of crabs diminishes the number of birds that visit Cape May, employment in industries serving birdwatchers may decline. Finally, the loss of migratory birds in Cape May could be considered an aesthetic impact.
Key impacts selected (critical socio-economic effects)	Employment, Aesthetics.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	NA
Quantification of exposure levels statewide	EQTWG indicates that several species have been overharvested. These include horseshoe crab, tuna, clam, and eel. Of these, the impact on the horseshoe crab is best documented. In 1990, state officials estimated that there were about 1 million crabs on bay shores during the May/June spawning season. In 1999, the estimate was about 400,000.
Specific socio-economic entities at increased risk	Workers in the fishing industry.
Quantification of exposure levels to entities at increased risk	Virtually all of the risk is for professional fishers.
Dose/Impact-Response Assessment	

Quantitative/Qualitative impact-assessment employed	Potential employment loss calculated by estimating downward trends in marine yields due to overharvesting.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: No impact hypothesized	*0.1*
	Duration/irreversibility	1
	Scale	1
	Confidence Severity: **Commercial Fishing:** In 1997 there were approximately 3000 commercial fishing jobs in NJ. Since the cutoff line for a moderate employment impact is 20,000 jobs under NJCRP guidelines, even a complete elimination of this industry would result in a score of "1" in this category. Still, it is possible to arrive at a plausible estimate of the number of jobs threatened by overharvesting. In 1997, commercial marine fishing boats in NJ sold fish with a dockside value of $104 million. This means that there is about 1 fishing job for each $35,000 in dockside value. (It should be noted that this $35,000 in value is divided between labor and capital, so the individual fisher probably earns much less than $35,000 per year.) Throughout the 1990s, fishing yields dropped steadily at a rate of $2.6 million per year, using constant 1999 dollars (r^2=.89). If this continues for the next five years, then revenues in five years will be $13 million lower than today. At the rate of $35,000 per job, this amounts to a job loss of nearly 400 over five years. It should be noted that it is not clear that all of the decline in marine harvests has been associated with overharvesting. Still, harvests of each of the four sea creatures mentioned by EQTWG (tuna, eel, crab, clam) have declined throughout the 1990s. **Birdwatching:** In addition, it is conceivable that a decline in migratory birds in Cape May will result in a decline in ecotourism jobs (see aesthetic impact section below for description of this problem). In June, 1997, 3,776 persons were employed in the lodging industry in Cape May County, while 8,177 were employed in restaurants, for a total of 12,000 in the hospitality industry. Since the NJCRP cutoff value for a moderate employment impact is 20,000 jobs, even a complete elimination of these industries would be scored a "1" under NJCRP guidelines. In addition, it is highly unlikely that the current loss of birds would result in measurable job losses in either of these industries. 1) Some restaurant traffic probably consists of local customers. 2) Hundreds of thousands of birds continue to roost at Cape May in May/June, so it is unlikely that vast numbers of birdwatchers would choose to stay home rather than go to Cape May. If 10% of the May/June tourists stayed home, and if this resulted in a commensurate loss of jobs throughout the hospitality industry, the resultant job loss would be 1,200.	1 *1*

	Recreational Fishing: The SETWG Brown Tide writeup reports that marine recreational fishing brings about 786,000 visitors to New Jersey, and brings $46 million into the NJ economy. This estimate does not cover shellfish. In this writeup, Tuna is the only non-shellfish fish discussed. Tuna is considered a "big game" fish. Nationally, only 1.4% of marine fishing trips pursue big game fish. Of these, not all are tuna. If we apply this 1.4% figure to the $46 million total fishing impact figure, we find that big game contributes only $46 million * 1.4% = $644,000. This probably represents far less than 100 jobs. It is more difficult to estimate the economic impact of recreational shellfishing. NOAA calls recreational shellfishing "almost totally undocumented." NOAA does estimate, though, that about 1 million persons engage in shellfishing activities each year. If we assume that the number of recreational shellfishers in each state is proportional to the total commercial	
	shellfish yield, then NJ accounts for 7.5% of all recreational shellfishing. (To arrive at this figure, I added the total commercial yield of clams, crabs, oysters, scallops, mussels, shrimp, and lobsters for the US and for NJ, according to NMFS data. NJ accounted for 7.5% of the commercial harvest of these species.) Therefore, if 1 million persons engage in recreational shellfishing and if 7.5% of these pursue this activity in NJ, then there are 75,000 recreational shellfishing trips in NJ each year. This is about 10% of the recreational finfish impact cited above. Therefore, if recreational finfishing accounts for about $46 million, then recreational shellfishing accounts for about $4.6 million. If we assume that it takes about $35,000 split between labor and capital to support 1 fulltime job, then the total loss of $4.6 million would destroy about 130 jobs. Of course, it is unlikely that the impact on recreational shellfishing would be even this high, since there is no reason to believe that 100% of the recreational shellfishing trade will be lost because of overharvesting. To summarize: The effect of overharvesting on employment, including jobs in commercial fishing, services for birdwatchers, and services for recreational fishers, is unlikely to total as much as 1,000 jobs. _____ Duration/irreversibility	_____ 1
	Scale	1
	Confidence: I am highly confident that job loss associated with overharvesting is less than 20,000 per year.	1
Costs Incurred	Severity: No impact hypothesized	*0.1*
	Duration/irreversibility	1
	Scale	1
	Confidence	1
Aesthetic Levels	Severity: Each year, migratory shore birds fly from South America to Canada. In May and early June, hundreds of thousands of these birds roost at Cape May, where they feed on horseshoe crab larvae. In 1999, news reports indicated that the number of birds had decreased 40% since 1986, from 450,000 to 275,000. The drop paralleled a similar decline in the number of horseshoe crabs. The May/June migration is considered one of the prime birdwatching opportunities on the East Coast. A 40% reduction in migratory birds may reasonably be considered a moderate aesthetic impact.	*2*
	Duration/irreversibility: Ecologists hope that 1997 regulations on horseshoe crab fishing in Delaware Bay will, in time, revive both the horseshoe crab and migratory bird populations. However, the recovery will probably require several years.	2
	Scale: This impact is highly localized at Cape May.	1
	Confidence: I am moderately confident of this assessment.	2

Psychological Impacts	Severity: No impact hypothesized	*0.1*
	Duration/irreversibility:	1
	Scale:	1
	Confidence	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L The industries potentially affected by overharvesting employ too few people to warrant a moderate impact rating.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ In 1997, Governor Whitman signed into law regulations that limited the number of horseshoe crab fishing permits. While it may take years for the population to rebound, the trend is expected to be positive.	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)		
Extent to which threat is currently regulated	In 1997, Governor Whitman signed into law regulations that limited the number of crab fishing permits.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	L	
Small business industry	H: Commercial Fishing	
Transportation	L	
Residential	L	
Agriculture	H: Commercial fishing	
Recreation	M: Recreational fishing contributes	

Issue: Overharvesting (Marine)
Author: John Posey
Version: 01/01

Resource extraction	H: Commercial Fishing
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	National Marine Fisheries Service. Fisheries Dependent Data. Www.st.nmfs.gov/st1/econ/ New Jersey Department of Agriculture. Fish & Seafood Development Program. www.state.nj.us/agriculture/rural/fish.htm New Jersey Employment Security Division. Employment and Wages, 1997. radburn.rutgers.edu/andrews/projects/njcrp/es97.xls National Oceanic and Atmospheric Administration. State of the Coastal Environment: Classified Shellfish Growing Waters." 1998. http://state-of-coast.noaa.gov Anthony Twyman. "Migratory Species at Shore Decline: Economic and Ecological Impact Stirs Fears." *New Jersey Star-Ledger*, 6/31/99. Tom Johnson. "Ecological Disaster or Contrived Crisis? Worried Scientists Descend on Beaches to Solve a Mystery." *New Jersey Star Ledger*, 6/19/98. "Editorial: The Crab Harvest." *New Jersey Star Ledger*, 9/4/97. Tom Johnson. "Shorebird Mystery along Delaware Bay: Some Experts Believe Migration Jeopardized by Decline in Delaware Bay Horseshoe Crabs." *New Jersey Star Ledger*, 5/18/97.
Current Policy and Regulatory Framework	See "regulation," above
Federal	
State & Local	

Issue: Overharvesting (Marine)
Author: John Posey
Version: 01/01

Overharvesting of clams, crabs, eels and tuna has been blamed for a decline in commercial fishing yields. However, relatively few persons are employed as professional fishers, so the potential job loss is a few hundred, at most. Overharvesting of horseshoe crabs has been associated with a decline in certain migratory bird populations. While there are probably no measurable economic impacts, this loss may reasonably be considered a moderate aesthetic impact.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	1	0.1	2	0.1
Duration/ Irreversibility	1	1	1	2	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	1	0.1	4	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
1.06	**1.06**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	1	2	1	1.2

Trend: +

Catastrophic Potential: L

Issue: Ozone (Ground Level)
Author: Clinton Andrews
Version: 05/01

NJ Comparative Risk Project
Socio-Economic TWG
Stressor-Specific Risk Assessment

Risk Assessment Framework	
Hazard Identification	**Ozone (Ground Level)**
Stressor	Ground-level ozone, also called ambient or tropospheric ozone (as distinguished from stratospheric ozone) and referred to herein simply as "ozone" or "O3", the chemical symbol. No other photochemical oxidants have been considered.
Description of stressor	Ozone is one of a class of compounds called photochemical oxidants that result from chemical reactions between various nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the presence of sunlight. (Other chemical reactions also produce ozone, but the reaction between N0x and VOCs is the most significant type of reaction.) Motor vehicle exhaust is a primary source of NOx and VOCs, which are referred to as "precursor" compounds. The complex mixture of airborne pollutants present on days characterized by high ozone concentrations (see below) is commonly referred to as "smog".
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Human Health: ozone has been associated with a variety of respiratory problems, especially asthma, but also including acute and chronic bronchitis, COPD (chronic obstructive pulmonary disease), reduced pulmonary (i.e., lung) function, and premature death. Ecological Effects: theoretically, the ozone-related health effects experienced by humans could also affect domestic (farm and household) and non-domestic ("wild") animals; however, no studies of this hypothetical impact have been found in the literature. There are studies linking ozone with various types of damage to agricultural crops, domestic plants (e.g., shrubs), trees, forests, and other plant life.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	**1 Damage Costs I:** direct costs of illness (e.g., medical bills), indirect costs of illness (e.g., foregone income), imputed costs of restricted activity days, and costs of premature death. **2 Damage Costs II:** direct economic losses, e.g., as a result of reduced crop yields or damage to ozone-sensitive materials such as fabrics, dyes, artworks, etc. **3 Property Values:** no impacts identified. **4 Social Costs:** worry related to respiratory illness. **5 Aesthetic Costs:** As a component of smog, ozone contributes to reduced visibility on high-smog days, which affects both New Jersey residents and those visiting the state for recreational purposes. **6 Employment:** no impacts identified.
Key impacts selected (critical socio-economic effects)	Damage Costs

<table>
<tr><td>Risk Assessment Framework</td><td>Findings/Notes</td></tr>
<tr><td>Exposure Assessment</td><td></td></tr>
<tr><td>Entities, exposure routes and pathways considered</td><td>All exposure to ozone is considered to be via inhalation or direct contact with ground-level air. Assessment focuses on individuals, with some attention to farms. Ozone concentrations are assumed to be reasonable proxies for exposures.</td></tr>
<tr><td>Quantification of exposure levels statewide</td><td>Because strong sunlight is essential for ozone formation, all of the readily available exposure data relates to the ozone “season”, defined in New Jersey as April 1 through October 31 of each year. Exposure levels are most often quantified in terms of the maximum 1-hour exposures on each day during that period; more limited information on maximum 8-hour exposures is also available. For regulatory reasons described below, the single most-cited statistic on exposure levels is
the number of days (termed “exceedance days”) on which the maximum 1-hour ozone concentration at a particular monitoring site exceeds 0.12 parts per million (ppm), the EPA standard through 1997.

Ozone concentrations on any given day vary somewhat throughout the state; New Jersey currently measures ozone concentrations at 14 monitoring stations, but the number of stations was higher in earlier years. In combining data from different sites to produce estimates of statewide exposure levels, it must be decided whether to weight each site’s data
by the population of that site’s “catchment” area. Such areas are most readily defined at the county level; however, since the number of stations (currently 14) is smaller than the number of counties in the state (21), one needs to decide which stations the other 7 counties should be assigned to. While geographic proximity and similarity of terrain are obvious
factors to be considered in making such assignments, prevailing surface wind patterns are probably even more important.

Based on NJDEP and EPA data, statewide maximum 1-hour ozone concentrations in recent years (measured in parts per million) can be summarized as follows relative to the 1-hour standard of 0.12 ppm (final data for 2000 is not yet available):

<table>
<tr><th>Year</th><th>Maximum 1-hr. level</th><th>Minimum 1-hr. level</th><th>Average 1-hr. level</th><th>Median 1-hr. level</th><th>No. of days > 1-hr. std.*</th></tr>
<tr><td>1995</td><td>0.170</td><td></td><td></td><td></td><td>14</td></tr>
<tr><td>1996</td><td>0.137</td><td></td><td></td><td></td><td>6</td></tr>
<tr><td>1997</td><td>0.176</td><td></td><td></td><td></td><td>10</td></tr>
<tr><td>1998</td><td>0.139</td><td></td><td></td><td></td><td>4</td></tr>
<tr><td>1999</td><td>0.157</td><td>0.003</td><td>0.0574</td><td>0.055</td><td>10</td></tr>
</table>
* at any monitoring site. Particular exceedance days may affect different stations and/or different numbers of stations.</td></tr>
</table>

<table>
<tr><td>Risk Assessment Framework</td><td>Findings/Notes</td></tr>
<tr><td>Exposure Assessment</td><td></td></tr>
<tr><td></td><td>Relative to the 8-hour standard of 0.08 ppm promulgated in 1997, statewide concentrations in recent years can be summarized as follows:

<table>
<tr><th><u>Year</u></th><th>Maximum
<u>8-hr. level</u></th><th>Minimum
<u>8-hr. level</u></th><th>Average
<u>8-hr. level</u></th><th>Median
<u>8-hr. level</u></th><th>No. of days
<u>> 8-hr. std.*</u></th></tr>
<tr><td>1998</td><td>0.113</td><td></td><td></td><td></td><td>47</td></tr>
<tr><td>1999</td><td>0.135</td><td>0.002</td><td>0.0513</td><td>0.0465</td><td>46</td></tr>
</table>
* at any monitoring site. Particular exceedance days may affect different sites and/or different numbers of sites.

The tables above show that ozone concentrations have fluctuated markedly from year to year, depending on weather and other factors. (Ozone levels in the 1980s and early 1990s were generally higher than those for the years shown.) Since weather in particular cannot be predicted with confidence for the coming years, the most that one can do in terms of quantifying <u>future</u> exposure levels is to develop an estimate based on historical information, assuming no major changes
in factors such as vehicle miles traveled (VMT) and no outside impacts from causes such as global climate change.</td></tr>
<tr><td>Specific socio-economic entities at increased risk</td><td>1 Human Health Effects: the most vulnerable populations are those with pre-existing respiratory disease or illness, infirm elderly, children, and adults exercising outdoors on “high ozone” days. There is also some indication in the literature that a certain percentage of seemingly healthy adults are especially sensitive to ozone.
2 Other Damage Costs: the principal affected entities would be the state’s farmers.
3 Property Values: n/a
4 Social Costs: the most affected populations would be those with an identified vulnerability, namely those with pre-existing respiratory disease or illness and possibly the infirm elderly. Asthmatics would be particularly at risk because of the high stress associated with a sudden inability to breathe freely. Another potential cost is associated with changed behavior on high ozone days. If individuals must avoid preferred activities, this may be linked to economic impacts. Unfortunately, evidence on changed behavior due to ozone is currently not available.
5 Aesthetic Costs: n/a</td></tr>
<tr><td>Quantification of exposure levels to entities at increased risk</td><td>Existing air quality data is not sufficiently precise to permit pinpointing of ozone exposure to high-risk groups, many of which are found throughout the state in any case. Therefore, exposure levels for those groups are assumed to be the same as for the general population (see above).</td></tr>
</table>

Risk Assessment Framework	Findings/Notes
Dose-Response Assessment	
Quantitative/Qualitative Impact Assessment Employed	Since enactment of the original Clean Air Act in 1970, there have been literally thousands of studies of the health and other impacts of ground-level ozone. In 1997, as part of a statutorily required review of the costs and benefits of the Clean Air Act, EPA staff and contractors reviewed the then-extant literature to identify the most reliable studies for use in EPA's evaluation of the Act's health benefits. The results of that review were published as The Benefits and Costs of the Clean Air Act, 1990 to 2010, Appendix D. Based on its review of the scientific literature, EPA determined that "concentration-response functions" involving ozone and the following 6 human health endpoints were sufficiently well documented to be used in its benefits assessment: **1** Self-reported **asthma attacks** (in asthmatics) not requiring hospitalization or emergency room treatment **2** **Emergency room visits** for asthma episodes **3** Onset of **new chronic asthma cases** among previously non-asthmatic adults **4** Hospital **admissions** for any of a number of identified **respiratory** illnesses **5** Hospital **admissions** for **cardiovascular** illnesses **6** Minor Restricted Activity Days (**MRADs**) characterized by any of 19 respiratory symptoms While a number of studies reported a link between ozone and premature mortality, EPA concluded that it was impossible to determine whether that health endpoint was caused by ozone or by particulate matter (PM) and therefore chose <u>not</u> to include premature mortality in its evaluation of ozone-related health effects. Lost work/school time was also excluded. For most of the 6 ozone-related health effects listed above, EPA identified one or more Concentration-Response (C-R) functions to be used in its benefits analysis; the functions are listed in Attachment A. As can be seen, many of the C-R functions are in "log-linear" form; the remainder are in linear form. As each function is based on the specific scientific study cited, Attachment A also lists the population used in each study. While it may be possible to generalize from the specific population used in a particular study to other populations, the present analysis does not do so. For that reason, the annual frequency of the various health effects as estimated in this study may understate the true health effects. Note also that the studies cited in Attachment A used different measures of ozone concentration as the independent variable. While many used the change in maximum 1-hour concentration, others used the change in 5-hour, 8-hour, and 12-hour average concentrations. Since data on 5-hour and 12-hour concentrations are not readily available,

Risk Assessment Framework	Findings/Notes
Dose-Response Assessment, cont.	
Quantitative/Qualitative Impact Assessment Employed, cont.	the required information was generated by using straight-line interpolation between 1-hour and 8-hour data for the esti-mated 5-hour concentrations and straight-line extrapolation for the estimated 12-hour levels. Also, 8-hour means were derived from 8-hour medians by assuming the same relationship between the two as between 1-hour means and medians. In performing actual risk calculations using the C-R functions described in Attachment A, it is necessary to precisely define "the risk", that is, the assumed reduction in ozone concentrations for which health effects are to be assessed. The implication is that exposed populations will continue to experience ozone concentrations below that level. There are several ways of handling this issue: **1** At one extreme, one might say that the difference between New Jersey's actual ozone concentrations and a concentration of zero is the reduction to be evaluated. This approach is based on the fact that studies have not established a clear "threshold" below which health effects are zero. However, this is an unrealistic scenario because ozone levels of zero are not attainable, given that some amount of ozone occurs naturally. **2** One could define the assumed reduction as the difference between actual ozone levels and "background", i.e., the "natural" levels that would remain even if all sources of the ozone precursors were "cleaned up". Most sources cite background as about .003 or .004 ppm. While this definition is not as extreme as the first, it still represents an unobtainable level given present technology. **3** The assumed reduction could be defined as the difference between actual ozone levels and the levels that would occur if New Jersey were in full compliance with EPA's proposed 8-hour standard, which standard has been endorsed by NJ DEP. That standard would imply no 8-hour ozone levels above 0.084 ppm. (Note: while the 8-hour standard is 0.08 ppm, any value less than 0.085 will round down to 0.08.) New Jersey has had a relatively large number of days in recent years on which this standard was exceeded, and therefore this measure would imply a relatively high level of benefits from reducing ozone concentrations from actual levels. **4** At the other extreme, one could define the assumed reduction as the difference between actual ozone levels and the levels that would occur if New Jersey were in full compliance with EPA's previous 1-hour standard. That standard implies no 1-hour ozone levels above 0.124 ppm. (Note: while the 1-hour standard is 0.12 ppm, any value less than 0.125 will round down to 0.12.) Since New Jersey had relatively few days in recent years on which this standard was exceeded, this measure would imply a relatively low level of benefits from reducing ozone concentrations from actual.

Risk Assessment Framework	Findings/Notes
Dose-Response Assessment, cont.	
Quantitative/Qualitative Impact Assessment Employed, cont.	**5** Finally, one could define a rate of health benefits per unit reduction in ozone concentrations, i.e., benefits per 1 ppm. While this approach is perhaps the simplest, it does not allow us to quantify an absolute dollar amount of benefits to be expected from reducing the ozone risk. Because New Jersey has officially endorsed EPA's 8-hour standard as superior to the previous 1-hour standard, the third approach is used in the present analysis. However, compliance with the 8-hour standard automatically entails meeting the 1-hour standard as well. According to NJDEP, a 1-hour max of .100 ppm equates to an 8-hour average of .008 ppm. Attachments B-E show the results of applying the C-R functions from Attachment A to the actual or imputed ozone concentration data from 1999. Those results can be summarized as follows: **Endpoint** / Low-End Est. / Middle Est. / High-End Est. / EPA 48-States / Pro Rata NJ / **Pro Rata/High** ER Visits / 9 / 19 / 29 / 3,100 / 88 / 3.0x New Asthma / 118 / 234 / 353 / 5,600 / 172 / 0.5x Respir. Adms. / 81 / 114 / 164 / 13,000 / 406 / 2.5x Cardio. Adms. / 223 / 246 / 261 / 22,000 / 624 / 2.4x Asthma Attacks / 1,962 / 3,423 / 5,078 / 1,100,000 / 27,180 / 5.4x MRADs / 39,860 / 59,817 / 93,798 / 19,000,000 / 572,607 / 6.1x The table also includes EPA's 48-state mean benefit estimates for 2000 and a pro rata allocation of those benefits to New Jersey based solely on New Jersey's population (see Attachment F). As can be seen, even the high-end model results differ from the "crude" estimates by factors ranging from 0.5 to 6.1. Since the magnitude of a state's health benefits depends not only on the state's population but also on its ozone levels, the pro rata estimates probably under-state New Jersey's share of the national benefits. Attachment G shows how the monetary values of the health endpoints are determined. The dollar amounts per unit are from the previously cited 1997 EPA study. Since EPA stated the monetary values in 1990 dollars, inflation to 2000 has been added based on the all-items urban CPI. The monetary values are summarized below ($000):

Risk Assessment Framework	Findings/Notes
Dose-Response Assessment, cont.	

Endpoint	Low-End Est.	Middle Est.	High-End Est.	Pro Rata NJ	**Pro Rata/High**
ER Visits	$ 106	$ 231	$ 350	$ 1,050	3.0x
New Asthma	3,925	7,763	11,707	5,712	0.5x
Respir. Adms.	1,508	2,124	3,046	7,543	2.5x
Cardio. Adms.	5,510	6,086	6,443	15,394	2.4x
Asthma Attacks	83	145	216	1,154	5.3x
MRADs	2,010	3,017	4,730	28,877	6.1x
TOTAL	**13,144**	**19,367**	**26,492**	**59,730**	**2.3x**

Once again, even the high-end model results differ from the "crude" estimates by factors ranging from 0.5 to 6.1 times or 2.3 times overall. As noted above, the pro rata estimates probably understate New Jersey's share of the national benefits.

IMPACT ON FORESTS

In its 1997 report on the benefits of the Clean Air Act, EPA estimated annual benefits of $600 million from avoiding reduced tree growth by reducing ozone levels. However, EPA also noted wide variations in the estimates due to uncertainties in the dose-response relationships and in the future price of commercial timber. For these reasons, and because EPA did not provide sufficient detail on its methodology to permit us to replicate it, this potential impact is not included herein. We note that New Jersey has an estimated 1.8 million forested acres, while the United States as a whole has 191 million acres in the national forests alone. This means that New Jersey's share of the national benefit is below 1%.

IMPACT ON CROPS

A number of studies have linked ozone exposure to damage to commercially valuable crops, including field crops, fruits, and vegetables. However, EPA in 1997 determined that only the relationships for field crops were sufficiently supported by the scientific literature to include in its study. Field crops include corn, winter wheat, soybeans, cotton, peanuts, and sorghum. Of these, only corn, winter wheat, and soybeans are commercially important in New Jersey, according to the State Agriculture Department. The Department reports the following commercial values for these crops in 1998:

Risk Assessment Framework	Findings/Notes
Dose-Response Assessment, cont.	

CROP	VALUE	MIN. LOSS	MAX. LOSS
Corn	$28,426,000	.01%	.05%
Winter Wheat	7,296,000	.20%	5.07%
Soybeans	27,203,000	.26%	2.75%
TOTAL	$ 62,925,000	$88,162	$1,884,583

Allowing for inflation from 1998 to 2000, these estimates of annual impact come to $93,296 (minimum) and $1,994,331 (maximum) or about $0.1M and $2.0M respectively.

Risk Assessment Framework	Findings/Notes	
Risk Characterization		
Risk estimates by socio-economic entities at risk	**(See NJCRP Scoring System for guidelines on determining breakpoints on the factors listed below.)**	Score
Property Values	Severity—no documented effects	*0.1*
	Duration/irreversibility—n/a	1
	Scale—probably only significant in hot spots, but these occur statewide	2
	Uncertainty—fairly confident except for highly sensitive materials such as paintings in museums.	2
Employment	Severity—no documented effects	*0.1*
	Duration/irreversibility—n/a	1
	Scale— probably only significant in hot spots, but these occur statewide	2
	Uncertainty —fairly confident	2
Costs Incurred	Severity—see previous estimates of health damage costs	*2*

	Duration/irreversibility—reversible for minor impacts; potentially longer lasting for more severe impacts	2
	Scale—potentially statewide	3
	Uncertainty —moderately confident—methodology as applied to NJ shows less harm than prorating US results	2
Aesthetic Impacts	Severity—automotive smog not usually severe enough to reduce visibility substantially	*1*
	Duration/irreversibility—prolonged smog episodes are rare and usually dissipate overnight	1
	Scale— probably only significant in hot spots, but these occur statewide	2
	Uncertainty —fairly confident—highly subjective area	2
Psychological Impacts	Severity—no documented effects apart from health effects	*0.1*
	Duration/irreversibility—probably reversible as weather conditions change	1
	Scale— probably only significant in hot spots, but these occur statewide —air quality not usually severe enough to engender worry in and of itself	2
	Uncertainty —fairly confident	2

Risk Assessment Framework	Findings/Notes
Risk Characterization	
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	LOW. The ozone problem has been extensively studied since EPA issued the first ozone standards in 1971. (One source states that over 3,000 ozone-related studies have been conducted.) More detailed analysis could perhaps pin-point specific areas and sub-populations most at risk, but the statewide risk assessment would probably not be affected. Climate models are insufficiently reliable at present to produce accurate forecasts for areas as small as New Jersey.
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	ZERO. In principle, change could be any of the 7 options because of uncertainty about future weather conditions which affect ozone formation. However, barring major reductions in vehicles miles traveled, major cuts in NOx or VOC emissions in up-wind states, or major improvements in average vehicle fleet emissions of NOx or VOCs, changes are unlike-le to be in the positive (+) direction. Similarly, barring major increases in mean or peak solar radiation from global climate change or other causes, changes are unlikely to be strongly negative (-). Most likely future is probably year-to-year fluctuations between weak positive (single +), zero change (0), and weak negative (single -).
Potential for catastrophic impacts (H,M,L) and brief description	LOW. Potential for catastrophic impacts is probably low, although in specific areas on specific days, extremely high ozone concentrations may lead to more than the average amount of respiratory distress among vulnerable persons.
Incidence of impacts (affected sub-groups, variability, equity issues)	Recent reports indicate that a disproportionate amount of asthmatics live in inner cities. To the extent that ozone causes or exacerbates their condition, inner-city residents could therefore be disproportionately impacted by the human health effects. Impacts on property values would more likely be concentrated in suburban communities, and impacts on farm crops would be concentrated in rural areas of the state.
Extent to which threat is currently regulated / Current policy and regulatory framework:	

Federal	In 1997 EPA mandated a change from the less strict 1-hour standard of 0.12 ppm to the more strict 8-hour standard of 0.08 ppm. The new standard was challenged, and the courts required EPA to conduct further investigations before promulgating the 8-hour standard. EPA has yet to decide whether to challenge the court's decision.
State & Local	New Jersey is occasionally out of compliance with the 1-hour standard in specific localities. NJDEP projects that the state would frequently be out of compliance with the proposed 8-hour standard. NJ has charged that NOx and VOC emissions in up-wind states such as PA and Ohio are responsible for a substantial portion of the state's ozone problem.

Risk Assessment Framework	Findings/Notes
Relative Contributions of Sources to Risk (H,M,L); include details on sources	
NJ Primary Sources	
Large business/industry	H (fossil-fuel burning facilities generate ozone precursors)
Small business industry	L
Transportation	H (primary source on ozone precursors is motor vehicle exhaust)
Residential	M (some home heating systems generate ozone)
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	M (NOx and VOCs emitted in up-wind states, e.g., PA and Ohio)
Biota sinks	L

Issue: Ozone (Ground Level)
Author: Clinton Andrews
Version: 05/01

Risk Assessment Framework	Findings/Notes
References	A detailed listing of references is attached.

Ozone: Ambient, ground-level, or tropospheric ozone is produced by the interaction of various nitrogen oxides and volatile organic compounds (both originating principally in vehicle exhaust) in the presence of strong sunlight. It has been linked with a number of respiratory and cardiovascular ailments, especially asthma.

Socio-Economic Impact Evaluation of Environmental Issue (0-5 years):
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socio-Economic Impact Factors Affecting Risk Estimation:	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	2	1	0.1
Duration/ Irreversibility	1	1	2	1	1
Scale (spatial, population)	2	2	3	2	2
Total Risk	0.2	0.2	12	2	0.2

Average Risk (0–5 years)	**Average Risk (5 years plus)**
2.92	**2.92**

Socio-Economic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	2	2	2	2	2	2

Trend: 0

Catastrophic Potential: L

Issue: Particulate Matter
Author: John Posey
Version: 08/04/00

NJ Comparative Risk Project,
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Particulate Matter**
Description of stressor	Particulate matter is solid matter or liquid droplets from smoke, dust, fly ash or condensing vapors that can be suspended in the air for long periods of time. Particulate matter results from all types of combustion, materials abrasion, and dust. It is typically measured as either Total Suspended Particulates (TSP), particles smaller than 10 microns in diameter (PM_{10}), and/or particles smaller than 2.5 microns in diameter ($PM_{2.5}$). Particles smaller than 10 microns are of primary concern because they are inhaled deep into the lungs where they can interfere with lung function. There has been mounting evidence that $PM_{2.5}$ may be the most harmful form of particulates. Please see the human health write-up for a more detailed discussion.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Human Health: Particulate matter pollution has been associated with a variety of severe respiratory problems, including: asthma, chronic bronchitis, pneumonia, decreased lung function and premature death. Groups that appear to be the most sensitive to the effects of particulate matter, in terms of human health, include individuals with chronic lung or cardiovascular disease, asthmatics, and elderly people and young children. Ecological Health: To date, the ecological write up has not been completed.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values: No impacts considered because of problems of double counting. Economists typically assume that reductions in housing prices reflect a reduction of the "amenities" associated with living in a particular area, such as health, materials damage, and aesthetic considerations. In other parts of this analysis, we look at these amenities directly, rather than as they become embedded in housing prices. This approach of avoiding double counting is consistent with most economic analyses of this kind, including EPA's *Unfinished Business* comparative risk project. Employment: No impacts considered. Damage cost: Direct human health costs, including "restricted activity days" direct costs of illness Materials damage—soiling and discoloration effects on a wide variety of materials including paint, structural metals, and other building materials. In this analysis, only household soiling is examined. Aesthetics: Considered impact of lost visibility on residents and recreationists. Worry: If particulates affect the color or smell of the air, then worry could be a factor.
Key impacts selected (critical socio-economic effects)	Damage costs, Aesthetics
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	1. Damage costs related to restricted activity days and health care costs would apply to the entire population of New Jersey. 2. Damage costs related to materials damage would apply to all households in the state. Damage to other structures is not analyzed due to a lack of data. 3. Aesthetic damage from restricted visibility is considered for the residents of, and visitors to, New Jersey shore counties, the area for which some

	visibility data exists.
Quantification of exposure levels statewide	Overall, the level of TSP has been falling in New Jersey over the last 20 years (1998 State of Environment). The entire state has been meeting previous health standards for PM10 (annual average of 50 micrograms per cubic meter), but much of the state was expected not to meet the health standards for $PM_{2.5}$. In 1998, measurements of PM_{10} in the state indicated an average annual concentration of around 25 micrograms per cubic meter. Ambient concentrations of $PM_{2.5}$ were uncertain. Understanding of total exposure is incomplete because there is a lack of information about the concentrations of particulates that people are exposed to in indoor environments, where most people spend most of their days. See the human health write-up for more detail on exposure.
Specific socio-economic entities at increased risk	1. Direct health costs: Some groups are more susceptible to particulate related health effects, such as people with chronic lung or cardiovascular disease, asthmatics, the elderly, and children. See the human health write-up for more detail on populations at increased risk. 2. Materials damage: Lacking much location-specific data, we assume that all households are exposed to similar concentrations. 3. Aesthetic damage: With the large role that recreation plays in the New Jersey shore counties, aesthetic quality along the shore may be more highly valued. This is accounted for in the analysis detailed below.
Quantification of exposure levels to entities at increased risk	Exposure levels are not different for specific entities at risk than for other populations in the state. With better ambient air quality data, we might be able to identify areas that are pollution "hot spots" and where damages would be more severe. However, current data is not sufficient to do so.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	EPA's Regulatory Impact Analysis for Ozone, Particulate Matter, and Regional Haze uses various dose-impact values to measure the welfare effects of air pollution. Those relevant to this analysis are listed below. Health-related socio-economic costs: Direct health costs: EPA reports a number of "cost of illness" measures for various types of ailments. These measure the direct costs of treatment. Lost productivity/work days: EPA estimates the value of a lost work day at $83 and a minor "restricted activity day" at $38 per worker per day. In order to calculate direct health related costs from particulate exposure in New Jersey, it is necessary to understand the relationship between exposure (through inhalation) to ambient particulate concentrations and the incidents of health impacts (illnesses, lost work days, etc.). The human health write-up does not detail these dose-response relationships, but does affirm that numerous studies have identified a relationship between particulate matter and health. Some relevant studies are: Ostro (1983): A 10% increase in PM led to a 3.1% increase in "restricted activity days" for all people studied. Ostro and Rothschild (1989): Increase of 1 ug/m3 in fine particulates is associated with 1.58% increase in respiratory-related restricted activity days and a 0.82% increase in minor restricted activity days. Schwartz (1993): Increase of 10 ug/m3 in TSP is associated with an increase of 7% in the risk of chronic bronchitis and an increase of 6% in the risk of respiratory diagnosis by a physician. Other socio-economic costs: Household Soiling Damage: EPA estimates the cost of household soiling damage to be $2.50 per household per microgram/cubic meter increase in Total Suspended Particulates, of which PM_{10} and $PM_{2.5}$ are subsets. EPA reports that costs from other soiling or materials damage impacts are not sufficient to calculate. Visibility: Visibility is measured in terms of changes in deciviews (a common measure of visibility based on the attenuation of light over distance). Impacts from reduced visibility fall into two categories, residential visibility and recreational visibility (e.g., in national parks). Estimates of willingness to pay (note: not housing cost or tourist cost) for improved visibility used by EPA are $14 per unit decrease in deciview per household in residential areas and $7.30 to $11 per unit decrease in deciview per household for recreational areas. The different values for recreational costs represent "in-region" WTP (that is, households close to the park) and 'out of region" WTP (that is, households farther from the park). Here we use the county in which the recreational area is located as the in-region measure.

Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values: No impacts considered (see justification above)	Severity	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Employment. No impacts considered; thought to be minimal	Severity	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Costs Incurred	Severity: We cannot calculate direct health costs, but soiling costs alone total around $160 million per year, which is the threshold between a score of medium and high. Health costs, even if quite low, would bump costs incurred into the "high" category. Direct health costs: Average ambient concentrations of particulates in New Jersey have been well below EPA's health standards since at least 1996. Because these standards are health-based, we may be able to assume that direct health impacts have been relatively small for the New Jersey population as a whole. Health assessments of particulates typically assume that, below a certain threshold, there are no impacts, and average New Jersey concentrations may be below that threshold. Although it would be possible to calculate the cost savings of reducing particulate concentrations even further, this would not be appropriate if concentrations are already below dose-impact thresholds. A wrinkle in this assessment is the uncertainty about concentrations of $PM_{2.5}$ and emerging evidence of the impact of $PM_{2.5}$ on health. Emerging knowledge may show more significant health impacts from $PM_{2.5}$ across the state in the future. Soiling of households: Using 1998 New Jersey air monitoring data (yearly averages for selected counties) showing a statewide yearly average of around 24 ug/m3, 1990 census data on the number of households in NJ counties (around 2.7 million), and an EPA damage cost of $2.52 per ug/m3 of PM per household, the total cost of soiling from particulates comes to around $160 million.	*3*
	Duration/irreversibility: According to the human health write-up, health effects from particulate exposure are generally exacerbations of existing conditions, so removal of particulates may reduce the severity of, but not cure, related health problems. Chronic health problems solely due to particulates, therefore, appear to be rare and we assume that acute effects—particularly at concentrations found in New Jersey—are reversible. Soiling is easily reversed with washing or reductions in particulate concentrations.	1
	Scale: Impacts are statewide.	3
	Uncertainty: Low confidence because of lack of health impacts data and "back of the envelope" calculation for soiling costs. Also, the coverage of air monitors may miss "hot spots" or sporadic periods of high particulate concentrations that may lead to health impacts or particularly severe soiling.	3

Aesthetic Levels	Severity: Total monetized severity is around $45 million, in terms of people's "willingness to pay" (WTP) for improved visibility in recreational and residential areas. According to the quantitative thresholds specified for measuring the impact of "Direct costs," this would result in a score of medium. This medium score would also be given based on the qualitative scoring categories for aesthetic impacts because aesthetic impacts in this case can be describes as "an offense that is moderately annoying and can be adapted to with moderate inconvenience or expense." Recreational areas. The one area in New Jersey that falls under EPA's regional haze rule is the Brigantine Wilderness Area in Atlantic County, an area of shoreline estuaries. Haze problems similar to those found in Brigantine are assumed to affect recreational areas in the three shore counties—Ocean, Atlantic, and Cape May—in similar ways. At Brigantine, there is a 15 deciview drop in visibility on the 20% worst days of the year and a 6 deciview drop on the 20% medium range days of the year (from a baseline of the 20% best days). Using a WTP measure of $11/decrease in deciview for "in-region" households (i.e. in the three counties), these numbers result in total "social cost" damages of around $21 million. However, only around 15% of the haze can be attributed to particulates (EPA data), reducing the total social cost to around $6 million. Information on visibility impacts across New Jersey were not found. If we assume that the visibility impacts in the Brigantine Wilderness are roughly similar to that of New Jersey (in terms of the levels and frequency of impacts), the total social cost of visibility impacts for the state attributable to particulates is around $39 million.	*2*
	Duration/irreversibility: Haze from particulates is reversible if particulate concentrations are reduced, which would require fairly significant effort.	2
	Scale: Assumed to occur throughout New Jersey	3
	Uncertainty: Confidence is low based on the extrapolation of visibility data from one location in the state to the rest of the state and based on the applicability of the willingness to pay estimates for New Jersey and its recreation areas.	3
Psychological Impacts:	Severity: Hassenzahl reports anecdotal evidence of worry caused by yellowish seasonal pollen around San Francisco Bay area oil refineries. The yellow haze caused numerous complaints to the local air quality agency. Hassenzahl notes, "people who are already "on edge" (i.e., live in industrial areas) can be quite sensitive to particulates and odors, since both are easily observed and highly unknown (unknown being a major issue identified in the psychometric paradigm)." Although the lack of solid evidence regarding public concern is not available, the possibility that particulates are related to psychological impacts should not be discounted.	*1*
	Duration/irreversibility:	1
	Scale:	3
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	**L** There is considerably uncertainty and controversy over the impact of $PM_{2.5}$ on health, particularly for sensitive subpopulations. Further data may reveal more severe health impacts—and more direct health-related costs—than are discussed here. However, because "severity" is already given the highest score for "Direct costs," new information would not change the risk estimate.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ Risk from particulates is likely to fall in the future as new ambient air quality standards come into force and non-compliance areas are forced to reduce ambient concentrations.	

Potential for catastrophic impacts (H,M,L) and brief description	Low.
Incidence of impacts (affected sub-groups, variability, equity issues)	As discussed above, health impacts are mainly concentrated on those in poor health, asthmatics, the elderly, and children.
Extent to which threat is currently regulated	Particulate matter in outdoor air is regulated under federal standards and New Jersey has been consistently below these thresholds. These may become more strict as standards for $PM_{2.5}$ are established. As far as indoor concentrations are concerned, there are workplace standards but no residential standards.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	**See the human health write-up for a detailed discussion of the sources of particulates**
Large business/industry	M
Small business industry	M
Transportation	H
Residential	M
Agriculture	L/M
Recreation	L
Resource extraction	L/M: Gravel Pits.
Government	L
Natural sources/processes	L (Although there are natural sources such as sea salt, leaf litter, etc.)
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	H

Biota sinks	L
References	EPA Visibility Improvement Program: http://www.epa.gov/oar/vis/ New Jersey Department of Environmental Protection, *Air Quality Report 1998*: http://www.state.nj.us/dep/airmon/98rpt.htm New Jersey Department of Environmental Protection, Bureau of Air Monitoring: http://www.state.nj.us/dep/airmon/index.html New Jersey State of the Environment Report (1998). Ostro, B.D. (1983). "The Effects of Air Pollution on Work Loss and Morbidity". JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT, 10: 371-82. Ostro, B.D. & Rothschild, S. (1989). "Air Pollution and Acute Respiratory Morbidity: An Observational Study of Multiple Pollutants". ENVIRONMENTAL RESEARCH, 50: 238-247. Schwartz, J. (1993). "Particulate Air Pollution and Chronic Respiratory Disease". ENVIRONMENTAL RESEARCH, 62: 7-13.
Current Policy and Regulatory Framework	
Federal	
State & Local	

Issue: Particulate Matter
Author: John Posey
Version: 08/04/00

Particulates: Particulate matter is solid matter or liquid droplets from smoke, dust, fly ash or condensing vapors that can be suspended in the air for long periods of time. Particulate matter results from all types of combustion, materials abrasion, and dust. It is typically measured as either Total Suspended Particulates (TSP), particles smaller than 10 microns in diameter (PM_{10}), and/or particles smaller than 2.5 microns in diameter ($PM_{2.5}$). Particles smaller than 10 microns are of primary concern because they are inhaled deep into the lungs where they can interfere with lung function. There has been mounting evidence that $PM_{2.5}$ may be the most harmful form of particulates. Please see the human health write-up for a more detailed discussion.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	3	2	1
Duration/ Irreversibility	1	1	1	2	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	9	12	3

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
4.92	**4.92**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Confidence**
Confidence Level	1	1	3	3	1	1.8

Trend: +

Catastrophic Potential: L

Issue: Pesticides
Author: John Posey
Version: 03/28/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Pesticides**
Description of stressor	Includes insecticides and herbicides. Uses include agriculture, vermin and termite control, lawn care and algae control.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Medical research has found suspected links between pesticide exposure and childhood cancers, birth defects, Parkinson's Disease, and other neurological and developmental problems. Accidental poisonings are also a health hazard. Ecological risks include loss of biodiversity and biological integrity, particularly in aquatic and wetland ecosystems.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Health hazards result in medical costs, as well as in worry. Ecological impacts potentially threaten employment, and may be considered aesthetic impacts.
Key impacts selected (critical socio-economic effects)	Costs, psychological impacts, aesthetic impacts, employment.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Human exposure to pesticides can occur in several ways. 1) There is some pesticide residue in many fruits and vegetables, so ingestion is a common pathway. This represents a cross-border environmental problem, since most fruits and vegetables consumed in NJ come from out of state. 2) Use of pesticides in agriculture, and in home and garden, can result in inhalation. 3) Dermal contact is also a possibility, for soils treated with pesticides. 4) Contamination of drinking water can result from agricultural runoff, resulting in ingestion. Ecological impacts result primarily from agricultural pesticides, both current and historical, as well as from current animal poisons. HHTWG reports that 80-90% of exposure to pesticides occurs through the indoor environment.
Quantification of exposure levels statewide	HHTWG reports that each year in NJ, over 63,000 pounds of pesticides are applied for mosquito control, over 500,000 pounds are applied for lawn care, over 200,000 pounds for golf courses, and over 1.4 million pounds for agriculture. At least 1% to 5% moves offsite because of runoff. Fenske (1987) found in a survey that 34% of homes in NJ that were built before 1982 contained at least five times the EPA reference concentration for chlordane, a common termiticide used to treat homes and building materials. Despite these figures, HHTWG reports that exposure levels for individuals in NJ is unknown, and that this represents a serious data gap.
Specific socio-economic entities at increased risk	HHTWG reports that infants, children and the elderly may be at increased risk. HHTWG also points out that there may be a link between drinking unsafe water and the economic inability to mitigate it.

Quantification of exposure levels to entities at increased risk	Unknown.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	For cost-of-illness information, I rely on recently published articles concerning health effects of pesticides. For aesthetic, psychological and employment impacts, I rely on the work of David Pimentel of Cornell University.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: It is reasonable to hypothesize that historic pesticide use may affect property values. DEP estimates that up to 5% of the land in the state may have some level of contamination. The most significant problem is in fruit-growing areas that traditionally used large amounts of lead and arsenic based pesticides. A DEP task force studied the problem, and issued a report in 1999. It found that pesticide contamination is a significant problem when agricultural areas are developed for residential use. Developers are increasingly likely to demand soil tests before buying land formerly used for agriculture. If the presence of pesticides prevents residential development, then this could seriously reduce the value of the property. If 5% of the land is contaminated by pesticides, and if this contamination reduces the value of these lands by more than 10%, then it is possible that the statewide property value impact will be greater than 0.42% statewide. (0.42% is the threshold for a "medium" property value impact under NJCRP guidelines.) Regrettably, there is insufficient GIS data available to allow a more precise analysis of property value impacts. Without this detailed information, it is difficult to render a judgment with high confidence. I consider it equally likely for the property value impact to be a 1 or a 2. To be conservative, I will assign a score of 1, while noting the lack of confidence with an uncertainty rating of 3.	*1*
	Duration/irreversibility: DDT will eventually break down, but pesticides containing lead and arsenic will remain in the environment until remediation occurs. Remediation techniques are available, but may be costly. Costs per acre range from a few thousand dollars to over $100,000.	2
	Scale: Historic pesticide contamination is concentrated in six counties: Burlington, Cumberland, Gloucester, Hunterdon, Monmouth and Salem	2
	Uncertainty	3
Employment	Severity: There are two potential employment impacts. First, Pimental reports that pesticides cause over $300 million in annual losses to the honeybee industry. However, only about $250,000 worth of honey is produced in NJ each year, so this is unlikely to be a serious economic impact to this state. Second, Pimentel reports that pesticide-related fish kills result in $10 to $24 million nationally in damage each year. However, searches of NJ news sources for the past several years failed to reveal any major fish kills in this state that were linked to pesticides. It appears that this impact does not seriously threaten the several hundred jobs in the NJ fishing industry. Thus, the best available evidence indicates that pesticides do not cause serious employment impacts in NJ.	*1*
	Duration/irreversibility	1
	Scale	1
	Uncertainty	1

Costs Incurred	Severity: Pesticides appear to contribute to several serious illnesses. Following is a brief synopsis of recent literature related to the human health impact of pesticides: *Childhood Cancer:* Daniels et al. (2001) report that the use of pesticides in the home can more than double the chance of a child developing neuroblastoma. Neuroblastoma accounts for approximately 10% of all childhood tumors, and is usually fatal. There are about 550 new cases each year. Buckley et al. (2000) report that children exposed to household insecticides and professional extermination methods are three to seven times more likely to develop non-Hodgkin lymphoma, the third most common childhood malignancy. Peters (1987) found that children exposed to household pesticides are more likely to develop leukemia. In a study of children in Los Angeles, children living in pesticide treated homes were nearly four times more likely to develop the disease. If children lived in homes where pesticides were used in the garden as well, the risk increased to 6.5 times. *Birth Defects:* Bell (2001) reports that pesticide exposure increases miscarriage risk. Women living near large agricultural sites in North Carolina where pesticide treatments were used experienced a 40 to 120% increase in risk of miscarriage due to birth defects. Whitney et al. (1995) report that exposure to the now banned pesticide Dursban caused *in utero* brain damage in rats. They speculate that pesticides may be linked to human brain damage in infants as well. Machera (1995) exposed different types of test animals to the fungicide cyproconazole. He found that this exposure increased the risk of miscarriage by 8 times. In addition, birth defects, most notably cleft palate, were found in a significantly higher number of animals exposed to the pesticide. Loffredo et al. (2001) report that pregnant women who come into contact with weed killers and rat poisons faced an increased risk (2.8 times) of having an infant born with a rare heart defect called Transposition of the Great Arteries (TGA). *Parkinson's Disease:* Ritz et al. (2000) report that Parkinson's Disease is more common in agricultural counties in California than in non-agricultural counties, which may suggest a link between pesticides and the neurological disorder. Thiruchelvam et al. (2000) found links between pesticide exposure and Parkinson-like brain damage in mice. Parkinson's Disease affects more than 500,000 people in the U.S. *Occupational Exposure:* Several researchers have found a link between occupational exposure and disease. Fleming et al. (1999) found that pesticide applicators face increased risks of prostate cancer. Kross et al. (1996) find that golf course superintendents face a significantly increased risk of dying from brain cancer, lymphoma, prostate and large intestine cancer. An earlier study in the Journal of the National Cancer Institute (1983) found that Florida pesticide applicators faced nearly three times the normal risk for developing lung cancer. (It should be noted that occupational exposure is beyond the purview of NJCRP.)	*1*

	Other: Other reported pesticide-related ailments include immunological disorders (Thrasher, 1993), hyperactivity (Mitchell et al., 1989) A.D.D. (Kilburn and Thornton, 1995), and male infertility (Balash et al., 1987). In addition, it should be noted that nationally there are a significant number of accidental poisonings caused by pesticides. Pimentel (2000) claims that there are more than 90,000 such cases each year. Unfortunately, there is insufficient information about the exposure of NJ residents to pesticides, and there is no national estimate of the number of cancers and other illnesses caused by pesticides. In order to estimate costs of pesticide-related illnesses, it is necessary to have an estimate of the number of cases caused by pesticides. Regrettably, this is not available. The best documented types of ailments associated with pesticides are childhood cancers and accidental poisonings of all types. I offer the following as a rough estimate of the costs associated with these problems. The American Cancer Association estimates that there are about 12,400 cases of cancer among persons under the age of 20 each year. If pesticides contribute to 10% of these cases, then this would amount to 1,240 cases of cancer. If NJ has a proportionate number of these childhood cancers, this would amount to about 30-40 cases of pesticide-related childhood cancer each year. NIH estimates that a "typical" case of cancer costs about $80,000. Thus, if all of these assumptions are correct, then we would expect the annual cost of pesticide-related childhood cancers in NJ to cost $3-4 million. Pimentel reports that there are about 92,000 cases of pesticide-related poisonings each year in the U.S. Many of these result in relatively mild symptoms such as headaches, nausea and short-term respiratory problems. HHTWG reports that the NJ Poison Information and Education System receives about 4,500 calls related to pesticide poisoning, which means that NJ suffers a number of poisoning incidents that is roughly proportional to its population. It is not known how many of these incidents result in medical treatment. If we assume that each case results in an average medical bill of about $1000, then this would result in medical costs of about $4.5 million. (It should be noted that it is difficult to know how much of this problem falls within the purview of NJCRP. First, it is likely that a large number of these cases result from occupational exposure. Second, it is not clear that a toddler, for example, who drinks some household rat poison, is the victim of an "environmental" hazard. (If this is an environmental hazard, then would a similar handgun accident also be considered "environmental" in nature?)) If these costs are added together, the sum is about $8 million, or just half of what would be required to document a "moderate" impact under NJCRP guidelines. The extent of other potential impacts, such as birth defects and immunological disorders, is not documented well enough to determine even a rough calculation of costs. There is, then, insufficient evidence to warrant a severity score greater than "1." However, the high uncertainty rating indicates that the actual costs may be much higher. Duration/irreversibility: Positive trend lines indicate that the problem is not entirely irreversible.	1 2
	Scale: Statewide	3
	Uncertainty: Much uncertainty	3
Aesthetic Levels	Severity: Effects on biodiversity and biological integrity, documented by EQTWG, may be considered moderate aesthetic impacts.	*2*
	Duration/irreversibility: There does appear to be an improvement.	2
	Scale: Statewide	3

	Uncertainty: Highly uncertain	3
Psychological Impacts	Severity: Pimentel reports that surveys indicate that 97% of the public has some concern about pesticides in food. It is difficult to know from this datum whether the worry is mild or severe. Still, this evidence indicates that concern over pesticides potentially poses serious psychological impacts.	*3*
	Duration/irreversibility: Worry should abate if threats diminish over time.	2
	Scale: Statewide	3
	Uncertainty: Highly uncertain	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	H. Much more information is needed about the exposure of NJ residents to pesticides.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+++, according to HHTWG.	
Potential for catastrophic impacts (H,M,L) and brief description	H. HHTWG and EQTWG agree that pesticide use poses potentially catastrophic risks, mostly because of the risk of accidental release.	
Incidence of impacts (affected sub-groups, variability, equity issues)	Children and the elderly seem especially at risk. Ironically, this may be a threat that disproportionately affects middle and upper income households. Households that have lawns, and can afford to treat them with herbicides face additional risk. However, as noted above, exposure through the diet may disproportionately affect low-income households. In addition, indoor exposure probably affects poor urban renters disproportionately.	
Extent to which threat is currently regulated	See federal and state regulation, below.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		

Large business/industry	H: Principal manufacturers of pesticides include Monsanto and Dow.
Small business industry	H: Exterminators and lawn care professionals are responsible for a large amount of indoor exposure.
Transportation	M: HHTWG reports that exposure in airplanes, buses and mass transit vehicles and stations is not trivial.
Residential	H: Exposure from insect extermination and lawn and gardens.
Agriculture	H: Socio-economic impacts, including aesthetic impact of loss of biodiversity and worry over residues on food, come primarily from agricultural uses.
Recreation	M: Golf courses account for a significant proportion of pesticide use.
Resource extraction	L
Government	M: Spraying for mosquitoes contributes to exposure levels.
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	H: Pesticides in soil, dirt and particulates.
Non-local air sources incl. deposition	M: According to HHTWG, long range drift or global transport is significant.
Biota sinks	L
References	Aschengrau, Ann et al. (1996). Cancer Risk and Residential Proximity to Cranberry Cultivation in Massachusetts. *American Journal of Public Health* 86(9) pp. 1289-1296. Balash, A. et al. (1987). Effect of Chlordane on Testicular Tissues of Swiss Mice. *Bulletin of Environmental Contamination and Toxicology* 39(3) pp. 434-442. Bell, Erin (2001). A Case Control Study of Pesticides and Fetal Death Due to Congenital Anomalies. *Epidemiology* 12(2) pp. 148-56. Blair, A. et al. (1983). Lung Cancer and Other Causes of Death among Licensed Pesticide Applicators. *Journal of the National Cancer Institute* 71(1) pp. 31-37. Buckley, Jonathan et al. (2000). Pesticide Exposures in Children with Non-Hodgkin Lymphoma. *Cancer* 89(11) pp. 2315-2321. Daniels, Julie et al. (2001). Residential Pesticide Exposure and Neuroblastoma. *Epidemiology* 12(1) pp. 20-26.

	Fenske, Richard and Todd Sternbach (1987). Indoor Air Levels of Chlordane in Residences in New Jersey. *Bulletin of Environmental Contamination and Toxicology* 39(6) pp. 903-910. Fleming, L. et al. (1999). Cancer Incidence in a Cohort of Licensed Pesticide Applicators in Florida. *Journal of Occupational & Environmental Medicine* 41(4) pp. 279-88. Kilburn, Kaye and John Thornton (1995). Protracted Neurotoxicity from Chlordane Sprayed to Kill Termites. *Environmental Health Perspectives* 103 pp. 690-694. Kross, B. et al. (1996). Proportionate Mortality Study of Golf Course Superintendents. American Journal of Industrial Medicine 29(5) pp. 501-506. Lowengart, R. et al. (1987). Childhood leukemia and parents' occupational and home exposures. *Journal of the National Cancer Institute* 79 pp. 39-46. Machera K. Developmental Toxicity of Cyproconazole, an Inhibitor of Fungal Ergosterol Biosynthesis, in the Rat. *Bulletin of Environmental Contamination & Toxicology* 54(3) pp. 363-369. Mitchell, J. and S. Long (1989). The Behavioral Effects of Pesticides in Male Mice. *Neurotoxicology and Teratology* 11 pp. 45-50. New Jersey Department of Environmental Protection (2001). Pesticide Control and Local Programs. www.state.nj.us/dep/enforcement/pcp/ Pimentel, David (1997). Environmental and Economic Costs of Pesticide Use, chapter 1 in David Pimentel, ed., *Techniques for Reducing Pesticide Use: Economic and Environmental Benefits*. New York: Wiley. Ritz, B. and F. Yu (2000). Parkinson's Disease Mortality and Pesticide Exposure in California 1984-1994. *International Journal of Epidemiology* 29(2) pp. 323-329. Thiruchelvam, Mona et al. (2000). The Nigrostriatal Dopaminergic System as a Preferential Target of Repeated Exposures to Combined Paraquat and Maneb: Implications for Parkinson's Disease. *Journal of Neuroscience* 20 pp. 9207-9214. Thrasher, Jack et al. (1993). Immunologic Abnormalities in Humans Exposed to Chlorpyrifos: Preliminary Observations. *Archives of Environmental Health* 48(2) pp. 89-93. US EPA (2001). Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). www.epa.gov/pesticides/fifra.htm Whitney, K.D. et al. (1995). Developmental Neurotoxicity of Chlorpyrifos: Cellular Mechanisms. *Toxicology and Applied Pharmacology* 134 pp. 53-62.
Current Policy and Regulatory Framework	
Federal	The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1947 established the regulatory framework. FIFRA provides for the registration,

	storage and inspection of pesticides, and establishes penalties for violators. In the Nixon administration, the EPA assumed responsibility for enforcing this act. In 1999, EPA set down a new set of tolerances for pesticide amounts in food and animal feed. The EPA has banned the use of about 30 pesticides. Dursban, a popular home pesticide manufactured by Dow, was banned in 2000.
State & Local	In NJ, the Pesticide Control Program is part of DEP. The primary function of the Pesticide Control Program (PCP) is to ensure compliance with federal and state laws and regulations regarding the use, sale, transport, disposal, manufacture, and storage of pesticides in the state of New Jersey. It also promotes pollution prevention and pesticide use reduction initiatives through training and outreach activities involving alternative pest control strategies such as Integrated Pest Management (IPM). The Program consists of the Administrator's Office and two Bureaus. The Bureau of Pesticide Operations (BPO) is responsible for the certification and licensing of agricultural and commercial users of pesticides, and pesticide dealers. The Bureau of Pesticide Compliance (BPC) is responsible for enforcing the state code and the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

Issue: Pesticides
Author: John Posey
Version: 03/28/00

Issue description: Pesticides. Pesticides affect both human health and ecological quality. Human health impacts can result from contamination of drinking water, pesticide residue in food and exposure in and around the home. Most human exposure probably comes from the indoor and home environment. This includes lawn and garden herbicides and rat and insect poisons. A 1987 survey indicated that about a third of NJ homes built before 1982 contained unsafe levels of the pesticide chlordane in the air. Medical research has linked pesticides to childhood cancers. Other potential pesticide-related ailments include birth defects, immunological damage, neurological damage and male infertility. A rough estimate of pesticide-related illnesses in NJ indicates that the economic cost of these illnesses is probably less than the threshold for a "moderate" impact rating under NJCRP guidelines. However, there is much uncertainty about exposure levels and concentration-response relationships; consequently, it is possible that the actual costs are much higher. There is little evidence of significant employment impacts related to ecological impacts of pesticide use. However, the ecological impacts may be considered at least a moderate aesthetic impact. Finally, an FDA survey in 1989 found that 97% of the public has some concern about pesticide exposure in food. This may be considered a serious psychological impact. Uncertainty regarding aesthetic and psychological impacts is high due to the subjective nature of these judgments.

Socio-economic Impact Evaluation of Environmental Issue:

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).

Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	1	2	3
Duration/ Irreversibility	2	1	2	2	2
Scale (spatial, population)	2	1	3	3	3
Subtotal Risk	4	1	6	12	18

Average Risk (0 – 5 years)
8.2

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	3	1	3	3	3	2.6

Long-term socioeconomic impact estimate:

Average Risk (5 years plus) 7?

Trend: +++

Catastrophic Potential: H

Issue: Pets as Predators
Author: John Posey
Version: 11/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Pets as Predators

When allowed to roam outdoors, house cats can pose a considerable threat to birds and other wildlife. Unleashed dogs can also threaten some wildlife, although dogs have a smaller impact than cats. Researchers at Wichita State University have estimated that the 70 million U.S. house cats kill as many as 270 million birds each year. In addition, the American Bird Conservancy contends that members of at least 18 endangered or protected species have been killed by cats nationwide. These include 8 birds, 8 mammals, and 2 reptiles.

In New Jersey, migrating birds are believed to be threatened by cats, as well as by other factors. According to the New Jersey Division of Fish, Game and Wildlife, over 130 species of Neotropical migrant birds breed in NJ. Some 80 of these are songbirds. In recent decades there have been declines of many Neotropical bird populations in NJ. There are at least 4 birds whose breeding status is considered endangered. There are 16 birds assigned a non-breeding status of "special concern," indicating a potentially endangering population loss. According to the Division of Fish, Game and Wildlife, the most significant factors leading to the decline in bird population have been the physical transformation of the environment. This includes both habitat destruction and habitat fragmentation. However, free-ranging house cats are considered a contributing factor, particularly in areas characterized by habitat fragmentation.

Although dogs are less of a threat, canines have been known to harm wildlife. In 1998, unleashed dogs killed a young harp seal in a coastal area. Beachnesting birds such as piping plovers are also threatened by unleashed dogs. The Division of Fish, Game and Wildlife encourages all NJ dog owners to supervise and control their pets whenever they are outdoors.

It is possible to hypothesize that predation by pets might have an economic impact. The NJ economy benefits from the hobby of birdwatching. If cats were to threaten the survival of enough species of birds, then this could decrease the amount of birdwatching in NJ. This, however, is not likely to occur within the next five years.

According to the American Birding Association (ABA), $14.4 billion is spent nationally each year by birdwatchers. Of this amount, $6 billion is spent on trip related expenses, $7.6 billion is spent on equipment (including bird food), and the rest is spent on magazines and membership dues. The Audubon Society estimates that over 60 million adults watch wildlife, and 80% of these are birdwatchers. In New Jersey, birdwatching has the greatest economic impact in the Cape May region. The ABA estimates that more than 100,000 birdwatchers visit the region each year. The economic impact of birdwatching in Cape May has risen from $10 million in 1991 to more than $31 million in 1997.

Since birdwatching expenditures in NJ are rising rapidly, it appears that cats have not yet begun to exert a measurable economic toll on the NJ economy. In addition, cats are not the most significant cause of bird population decline in NJ. As noted above, habitat loss and fragmentation are considered more significant factors than cats. It is unfortunate that cats sometimes kill members of protected species of birds. However, it is not possible at this point to demonstrate that these occurrences have measurable socio-economic impacts.

EQTWG addressed potential impacts on the wider ecosystem. The severity rating assigned by EQTWG indicated that "ecosystem exposed, but structure and function hardly affected."

A reviewer added the following thought: "the significant estimates of bird killings, especially by free roaming house cats, suggests that public education efforts on this problem should be considered."

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AScribe Public Interest Newswire. "Study Finds Urban Cats on Average Kill Four Birds Each Year." AScribe News. May 9, 2000.

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Issue: Pets as Predators
Author: John Posey
Version: 11/00
Pets as predators: When allowed to roam outdoors, house cats can pose a considerable threat to birds and other wildlife. Unleashed dogs can also threaten some wildlife, although dogs have a smaller impact than cats. Researchers at Wichita State University have estimated that the 70 million U.S. house cats kill as many as 270 million birds each year. In addition, the American Bird Conservancy contends that members of at least 18 endangered or protected species have been killed by cats nationwide. These include 8 birds, 8 mammals, and 2 reptiles. In New Jersey, several species of migratory birds are considered endangered or of "special concern." Cats are not the most significant cause of these avian population declines, but cats are considered to be a contributing factor. While it is unfortunate that cats may kill some members of protected bird species, there currently are no measurable socio-economic effects.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	0.1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	0.2	0.2	0.2	0.2	0.2

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.2	0.2

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: L

Issue: Petroleum Spills
Author: John Posey
Version: 02/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Petroleum Spills**
Description of stressor	This category includes the accidental spillage of oil, whether from tanks, boats, or other storage containers. This includes both the risk of catastrophic releases (e.g., the Exxon Valdez), and chronic smaller-scale releases.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Oil spills can wreak environmental damage, threatening ecological integrity and biodiversity. Aquatic releases can reduce populations of birds, fish and shellfish. HHTWG declined to produce a writeup on this topic. However, human health impacts related to petroleum spills are covered under writeups on PAH and MTBE.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Following the lead of HHTWG, medical costs associated with human health impacts are not considered in this writeup. Impacts considered are: Employment losses resulting from losses of commercial fish and shellfish populations. Potential employment losses resulting from effect of catastrophic spill on beach tourism. Impact of leaking underground storage tanks (LUSTs) on values of surrounding properties. Potential impact of catastrophic spill on beachfront property. Cleanup costs. Aesthetic impacts related to environmental damage of Newark Bay and its tributaries, as well as other areas prone to accidental release. Fear of catastrophic spill.
Key impacts selected (critical socio-economic effects)	Employment, Property Values, Costs Incurred, Aesthetic Impact, Psychological Impact.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Industrial releases. Shipping releases LUSTs Potential catastrophic spill, i.e., tanker accident.
Quantification of exposure levels statewide	DEP estimates that there are up to 30,000 underground storage tanks in NJ in need of closure or repair. 2) Between 1986 and 1991 there were more than 1400 incidents involving petroleum spills in Newark Bay and tributaries. These accounted for more than 18 million gallons of petroleum released into the estuary. EQTWG reports that over 1000 releases occur each year in NJ waters, although most releases are less than 10 gallons. In the last 3 years, 11 releases in excess of 500 gallons occurred.
Specific socio-economic entities at increased risk	Properties near beach or LUST.
Quantification of exposure levels to entities at	Virtually all of the risk associated with petroleum spills will be concentrated near waterfronts or near LUSTs.

increased risk		
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Property value assessment based on hedonic model of LUST impact. Cost impact based on NJDEP data pertaining to releases and settlements. Qualitative assessments employed for aesthetic and psychological impacts.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: There are two possible ways that oil spills could affect property values. First, a catastrophic spill could diminish the value of beachfront property. Second, econometric literature reveals that LUSTs appear to damage the value of surrounding properties. Catastrophic spills are an example of a high-consequence/low-probability event. A spill on the order of the Valdez accident could threaten the value of very expensive beach properties on a significant portion of the NJ coast. However, a spill on this scale has never occurred in NJ waters, and most likely will not occur in the next five years. Hence, the expected value of a catastrophic spill may be considered fairly low. A hedonic regression analysis of the impact of LUSTs on property values has shown that residential properties within 300 feet of a LUST lose 8% of their value (ceteris paribus), while commercial properties may lose up to 17%. According to NJDEP, there are up to 30,000 USTs in need of repair or closure. The maximum land area that could be affected by these LUSTs may be assessed as follows: If we assume that there are no LUSTs within 600 feet of each other, and if we assume that most of the property value impact will occur within a 300 foot radius of the LUST, then the maximum land area affected in NJ amounts to: $300^2 * \pi * 30{,}000$ = 8.5 billion square feet = 302 square miles. This represents 3% of the land mass of NJ. If we assume that these properties have average values, and that each of these properties is commercial, then the property loss to the state as a whole would be .03 * .17 = 0.51%. In fact, however, it is unlikely that the property value impact is this high. First, there is probably some overlap between the 300 foot radii surrounding many of these LUSTs. Second, it is unlikely that all of the properties affected are commercial. Third, many of these properties are located in industrial areas that would have below average values for reasons unconnected to the presence of a LUST. For these reasons, it is unlikely that LUSTs reduce the value of properties in the state as a whole by as much as 0.42%, the cut-off point for a moderate impact under NJCRP guidelines.	*1*
	Duration/irreversibility:	1
	Scale	1
	Uncertainty: I am moderately confident that LUSTs reduce property values in NJ by less than 0.42%	2

Employment	Severity: A tanker spill, if perfectly timed and placed to cause maximum damage, could threaten thousands of tourism jobs in beachfront communities. As noted above, however, the probability of this occurring in the next five years is very low. Oil spills could potentially threaten jobs in the fishing industry. However, there currently are only a few hundred NJ jobs in this sector, so even a complete elimination of this sector would be ranked as a "1" under NJCRP guidelines. It could be argued that if Newark Bay and other areas had never been polluted, then these areas might support an additional number of jobs. However, commercial fishing has not been viable in Newark Bay in recent decades, and the growth of industries on Newark Bay probably generated more jobs than could ever have been supported in the fishing industry alone. For these reasons, oil spills probably threaten very few jobs.	*1*
	Duration/irreversibility	1
	Scale	1
	Uncertainty	2
Costs Incurred	Severity: According to EQTWG, settlements for oil spills obtained by NJDEP from polluters have averaged approximately $500,000 per year over the last 15 years. In addition, NJDEP has devoted at least $50 million to LUST cleanup over the last three years. According to NJDEP documents, the fund is available only to small businesses with fewer than 10 tanks. Thus, this amount represents only a portion of total cleanup costs. It is reasonable to surmise that LUST cleanup costs in NJ exceed $16 million per year, the cut-off point for a moderate impact under NJCRP guidelines. There is, however, some uncertainty regarding whether LUST cleanup costs are to be counted under NJCRP guidelines. In general, emergency cleanup is counted by NJCRP, while cleanup costs that are ongoing, routine, and regulatory in nature (e.g., scrubbers on power plant smokestacks) are not counted. It seems reasonable to count the cleanup of LUSTs that threaten drinking water supplies. If $16 million of the $50 million cleanup budget is going toward water-threatening LUSTs, then, it is appropriate to assign a score of "2" to this category.	*2*
	Duration/irreversibility: LUST remediation is expensive, but possible.	2
	Scale: LUSTs are most heavily concentrated in urban areas.	2
	Uncertainty: I am not highly confident of these assessments.	3
Aesthetic Levels	Severity: The loss of ecological integrity and biodiversity in industrialized estuaries in NJ may reasonably be considered a moderate aesthetic impact.	*2*
	Duration/irreversibility: Since contamination has accumulated for several decades, Newark Bay and other industrialized areas will probably not be made whole within our lifetimes.	3
	Scale: Effects are fairly localized.	1
	Uncertainty: I am moderately confident of these assessments.	2
Psychological Impacts	Severity: Gunning et al. (1992a and 1992b) maintains that events such as the Valdez catastrophe have made the public aware of and concerned about oil spills.	*2*
	Duration/irreversibility: As long as tankers are used to carry oil, the public will probably continue to be concerned about the possibility of catastrophic spills.	2
	Scale: Residents of ocean-front communities might be expected to be most concerned about damage to the ocean.	1
	Uncertainty: These assessments are fairly speculative.	3
Potential for additional data to result in a	M. More detailed data on the geographic placement of LUSTs would allow for a more precise estimate of property value impacts.	

significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ EQTWG expresses optimism about the continuing improvement of storage and clean-up technology.
Potential for catastrophic impacts (H,M,L) and brief description	M: According to EQTWG, "The Delaware River is the 3rd largest importer of crude oil in the country and the 5th largest in the world. With the width of the river and the amount of ship and barge traffic up and down the river the likeliness of a collision is high. Also, with the number of refineries and other production facilities along the both sides of the river the possibilities of an onshore spill and/or a loading/unloading accident occurring is not only high but probable, in spite of the precautions and regulations in place."
Incidence of impacts (affected sub-groups, variability, equity issues)	Urban areas have a higher concentration of LUSTs, ocean-front communities face a higher risk from catastrophic oil spills.
Extent to which threat is currently regulated	See Federal and State regulation, below.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	H
Small business industry	M
Transportation	H
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	L

Natural sources/processes	L
Orphan contaminated sites	H
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	D.W. Crawford et al. "Sources of Pollution and Sediment Contamination in Newark Bay, New Jersey." *Ecotoxicology and Environmental Safety* 30(1), 1995. Donald Gunster et al. "Assessment of Chemical Loadings to Newark Bay, New Jersey from Petroleum and Hazardous Chemical Accidents Occurring from 1986 to 1991." *Ecotoxicology and Environmental Safety* 25, 202-213 (1993a). Donald Gunster et al. "Petroleum and Hazardous Chemical Spills in Newark Bay, New Jersey, USA from 1982 to 1991." *Environmental Pollution* 82, 245-253 (1993b). S.L. Huntley et al. "Polycyclic Aromatic Hydrocarbon and Petroleum Hydrocarbon Contamination in Sediment from the Newark Bay Estuary, New Jersey." *Archives of Environmental Contamination and Toxicology* 28(1), 1995. New Jersey Department of Environmental Protection. "Fact Sheet: The Petroleum Underground Storage Tank Remediation, Upgrade and Closure Fund." November 19, 1999. www.state.nj.us/dep/srp/finance/ustffact.htm Robert A. Simons et al. "The Price and Liquidity Effects of UST Leaks from Gas Stations on Adjacent Properties." *Appraisal Journal*, 4/1/99. United States Environmental Protection Agency. "Oil Spill Program." www.epa.gov/oilspill R.J. Wenning et al. "Accumulation of Metals, Polychlorinated Biphenyls, and Polycyclic Aromatic Hydrocarbons in Sediments from the Lower Passaic River, New Jersey." *Archives of Environmental Contamination and Toxicology* 27(1), 1994.
Current Policy and Regulatory Framework	
Federal	The principal laws pertaining to oil spills are the Clean Water Act (CWA) and the Oil Pollution Act (OPA). The CWA prohibits the discharge of oil or hazardous substances into navigable waters in the US, and authorizes the President to establish enforcement mechanisms. The OPA specifies that the party responsible for an oil spill is liable for cleanup costs and damages. In addition, the Superfund Acts, CERCLA and SARA provide funds for cleanup and procedures for establishing liability. EPA has established regulations to fulfill these acts. The National Contingency Plan (NCP) is the EPA's strategy for cleaning up oil spills. The Oil Pollution Prevention Regulation requires all owners of oil storage facilities to prepare a Spill Prevention Control and Countermeasures (SPCC) program. The Discharge of Oil Regulation creates reporting requirements for any party responsible for an oil discharge.

Issue: Petroleum Spills
Author: John Posey
Version: 02/01

State & Local	In 1990, the Legislature passed a series of laws that came to be known as the Oil Spill Package. The passage of these laws was prompted by several spills in the Kill Van Kull and Arthur Kill Areas. These acts established penalties and allocated funds for enforcement. In addition, NJDEP has designed an inlet protection strategy, which includes the placement of booms to prevent oil from reaching channels. Finally, in 1997 Governor Whitman signed a law establishing the Petroleum Underground Storage Tank Remediation, Upgrade and Closure Fund within the New Jersey Economic Development Authority. The fund makes loans and grants to eligible owners.

Petroleum Spills: The issue of petroleum linkage includes three types of threat: First, more than 1000 spills occur in NJ waters each year, although most are less than 10 gallons. Between 1986 and 1992, more than 18 million gallons were spilled in NJ waters. Second, oil can leak into soil from underground storage tanks. Finally, a catastrophic spill on the order of the Exxon Valdez accident is an unlikely event that would have devastating consequences. Cleanup costs, both on land and sea, probably exceed $16 million annually in NJ. Oil spills have wrought devastation on Newark Bay and tributaries. The ecological consequences may be considered an aesthetic impact of at least moderate proportions. Finally, the public is aware of, and moderately concerned about, the possibility of a large-scale tanker accident.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	2	2	2
Duration/ Irreversibility	1	1	2	3	2
Scale (spatial, population)	1	1	2	1	1
Subtotal Risk	1	1	8	6	4

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
4	**4**

\Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	2	2	3	2	3	2.4

Trend: +

Catastrophic Potential: M

Issue: Pfiesteria
Author: John Posey
Version: 12/14/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	Findings/Notes
Hazard Identification	
Stressor	**Pfiesteria**
Description of stressor	Pfiesteria is a type of algae known as a toxic dinoflagellate. It lives in brackish and coastal waters and is naturally found in New Jersey. Most of its complex life cycle is spent in a harmless, non-toxic state. Pfiesteria becomes predatory and releases two to three toxins into the water for periods lasting only a few hours. See Ecological TWG report for full details.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	The toxins released by Pfiesteria can have serious human health effects, including lesions, respiratory distress, stomach cramping, behavior changes, erratic heart beat, and memory loss. Most of these symptoms are reversible. The Human Health TWG has not yet done an analysis for Pfiesteria. There are significant ecological impacts to fish, which die when they come into contract with the toxins. See Ecological TWG report for full details.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	• Property Values; Earnings/Employment; Costs Incurred; Aesthetic Levels; Social Cohesion; and Social Capital. Note that these are not additive, instead they are in many cases parallel measures of a single underlying phenomenon. For example, residential property values are said to represent the capitalized value of a stream of locational amenities such as recreational opportunities. Earnings and employment are closely linked and are dependent on the level of recreation industry activity.
Key impacts selected (critical socio-economic effects)	Earnings/ Employment, Property Values, Costs Incurred, Aesthetic Levels, Psychological Impacts.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Economic and social actors that depend on coastal ecosystems for economic and amenity benefits. Commercial fish producers, shorefront property owners, recreational coastal waterway users.
Quantification of exposure levels statewide	There has never been a confirmed outbreak in New Jersey. * Spatial: Areas with a moderate to high likelihood of experiencing an outbreak based on ecological conditions are the Delaware coastline, Monmouth County Raritan Bay coast, and the northern portion of the Barnegat Bay. * Temporal: Most outbreaks along the Atlantic coastline occur between June and August. While the toxic stage of Pfiesteria only last a few hours, the effects of the toxins can remain for up to three weeks.
Specific socio-economic entities at increased risk	Users of waterways along the Delaware coastline, Monmouth County Raritan Bay coast, and the northern portion of the Barnegat Bay.
Quantification of exposure levels to entities at	There has never been a confirmed outbreak in New Jersey. The Delaware coastline, Monmouth County Raritan Bay coast, and the northern portion of the Barnegat Bay are the areas in New Jersey most likely to experience a Pfiesteria outbreak (New Jersey Department of Health and Senior

increased risk	Services, 2000). Outbreaks are most likely to occur in the summer, the most popular time for recreational use of coastal waterways. Commercial fish producers, shorefront property owners, recreational coastal waterway users.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	We assumed that there was a linear relationship between the spatial extent of the outbreak and the socioeconomic impact. We assumed than an outbreak lasts less than a day, while the socio-economic impact can last up to three months after an outbreak.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	a) Severity Research suggests that 15% of a waterfront house's value be tied to its recreational and aesthetic value. The recreation and aesthetic value of homes within 2000 feet of a lake equaled 15% of the total market price of the houses (Lansford and Jones, 1995). We assume that the occurrence of a Pfiesteria outbreak will devalue the property value related to the recreation and aesthetic value characteristics. The total value of property in the Delaware coastline, Monmouth County Raritan Bay coast, and the northern portion of the Barnegat Bay is 25 billion dollars. In a worse case scenario, property values could decrease by 3.8 billion dollars due to a decrease in recreational and aesthetic value. It is extremely unlikely that all areas will be affected at the same time, or even over a five-year period.	1
	b) Duration/irreversibility We assume that the effects of a Pfiesteria outbreak are reversible within less than a year of the outbreak, due to the short-term impact on aesthetics and recreation (a maximum of 3 months). As there has never been a Pfiesteria outbreak in New Jersey, it is unlikely that there will suddenly be several outbreaks in the same location within a short (5 year) period.	1
	c) Scale The spatial impact of a Pfiesteria will be highly localized, based on evidence of outbreaks in other states.	1
	d) Uncertainty The confidence is moderate because although there is no data for New Jersey, as there has never been an outbreak in the state, the maximum impacts are likely to modest and short-lived. The specific impact of Pfiesteria outbreaks on property values in poorly documented.	2

Employment	a) Severity A Pfiesteria outbreak can kill all of the shellfish and finfish in the areas (Burkholder, 1998). Commercial Fishing: There is the potential for a tremendous impact on the commercial fishing industry in specific areas of New Jersey, if an outbreak occurs. The industries associated with commercial fishing are stable all year long, thus the percent was determined in a yearlong season. There are less than 100 people involved in commercial fishing in the counties whose coastal waterways have been identified as having a moderate or high risk of an outbreak (New Jersey Department of Health and Senior Services, 2000). There is one firm in Salem County manufacturing fresh and frozen fish (SIC 2092), with 9-19 employees. There are over one hundred and fifty employees involved in the wholesale trade of fish and seafood (SIC 5146) in the moderate to high-risk counties in New Jersey. Recreational: The employment impact of a decrease in recreational activity was quantified by a reduction in employment at marinas (SIC 4493) and hotels and other lodging places (SIC 0700). Recreational boating (including recreational fishing) and coastal tourism is concentrated in the summer months and the outbreaks are most likely to occur in the summer. Retail fish sales (including seafood restaurants) were not considered, as these industries can switch to another supplier of fish. If outbreaks occurred in all moderate to high risks counties in New Jersey, employment rates could decrease by 0.18%. This represents a worse case scenario as it is unlikely an outbreak will occur in all of these counties over the next five years.	1
	b) Duration/irreversibility Fish kills associated with an outbreak last up to three weeks (Burkholder, 1998). Due to public reaction, however, the effects of an outbreak on fishing related industries could be as long as three months (*http://www.mdsg.umd.edu/fish-health/pfiesteria/pfeconomics/index.html*).	1
	c) Scale Outbreaks are fairly localized so the effects on commercial fishing should be as well.	1
	d) Uncertainty The confidence is moderate because although there has never been an outbreak of Pfiesteria in New Jersey, its worst-case impacts on employment are minor. It is unclear how the public or fishing industry would react if an outbreak occurred.	2
Costs Incurred	a) Severity There are two main types of costs associated with an outbreak. The first is costs related to the impacts on the fishing industry. There would be a decline in yields, and a potential decline in demand. In Maryland there was a 17% decrease in revenue from fish and shellfish sales, after the 1997 Pfiesteria outbreak ((*http://www.mdsg.umd.edu/fish-health/pfiesteria/pfeconomics/index.htm*). The second type of costs would be medical. Exposure to the toxins released by Pfiesteria can lead to skin lesions, respiratory distress, stomach cramping, behavior changes, erratic heartbeat, and memory loss. Most people exposed to toxins were seen by a health care provider (Surveillance for Possible Estuary-Associated Syndrome - Six States, 1998-1999, 2000). Death is a highly unlikely possibility	1

	b) Duration/irreversibility Fish kills usually last only three weeks after a Pfiesteria outbreak. However, fish harvest may be down for a period significantly longer (Burkolder, 1998). Most effects on human health are reversible. Immediate removal from exposure site will halt some effects. Others may take several weeks or months. In a few cases, there are lingering effects for many years, which require extensive physical therapy (Glasgow et al., 1995).	1
	c) Scale There would be costs felt by all aspects of the fishing industry in the location of the outbreak. There would be additional costs felt by people who rely on revenues from recreational use of coastal areas.	1
	d) Uncertainty The confidence is only moderate because of the lack of New Jersey specific evidence. There is a limited understanding of the effects of the toxins on human health.	2
Aesthetic Levels	a) Severity An outbreak would offend sight and smell, due to the large numbers of dead and dying fish in the water and along the shoreline after a Pfiesteria outbreak. The offense could be avoided by halting use of waterways where the outbreak occurred.	1
	b) Duration/irreversibility Fish kills usually last up to three weeks. To remove the aesthetic impacts, the dead fish would need to be removed.	1
	c) Scale There has never been a Pfiesteria outbreak in New Jersey. While the risk of one occurring is increasing, due to the relationship between Pfiesteria and nutrient rich water, there is no where in the United States where outbreaks occur at regular intervals. Outbreaks are fairly localized, and limited to coastal areas.	1
	d) Uncertainty There has never been an outbreak in New Jersey so it is difficult to determine the impact of an outbreak.	1
Psychological Impacts	a) Severity: Scientific research has only begun to understand the relationship between Pfiesteria and fish kills and human health effects. This leads us to believe that most people are unfamiliar with the issue. There has never been an outbreak of Pfiesteria in New Jersey and the effects would be highly localized (occur only in the coastal waterways of one area), so is seems unlikely to arouse much worry.	1
	b) Duration/irreversibility: Pfiesteria outbreaks are difficult to identify. New Jersey has a plan to try to quickly identify an outbreak if there is evidence of fish kills or human health problem occurring (New Jersey Department of Health and Senior Service, 2000). Additionally, the effects of an outbreak last much longer than the actual outbreak (*http://www.mdsg.umd.edu/fish-health/pfiesteria/pfeconomics/index.html*).	1
	c) Scale: Only people using the waterways in one of the areas designated as having a moderate to high risk of an outbreak are likely to worry about the impacts.	1
	d) Uncertainty: The confidence level is low because there has been limited work considering the psychological effects of a Pfiesteria outbreak. There has been no research considering the effects in New Jersey.	3
Potential for additional data to result in a significant future change	H Currently there is no New Jersey specific data on the impact of a Pfiesteria outbreak.	

in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	There is little understanding of the impact of an outbreak on property values.
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	- Pfiesteria outbreaks occur more frequently in warm water with high nutrient content. Changes in water temperature from global climate change may affect Pfiesteria outbreaks. Currently, they only occur in the mid-Atlantic in the summer. An increase in water temperature may lead to additional months where outbreaks are possible. As phosphorous and nitrogen levels increase in coastal waterways, from agricultural and lawn run-off, the chance of outbreak increases.
Potential for catastrophic impacts (H,M,L) and brief description	L If an outbreak occurred, it is unlikely that the socioeconomic impacts would be widespread or long-term.
Incidence of impacts (affected sub-groups, variability, equity issues)	Pfiesteria outbreaks impact users of coastal waterways and waterfront property owners.
Extent to which threat is currently regulated	Unregulated, naturally occurring Nutrient control, through fertilizer use regulation, may be best regulatory option.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	L
Small business industry	L
Transportation	L
Residential	M Can increase chance of an outbreak as fertilizers run-off increases nutrient levels in coastal waterways.
Agriculture	M Can increase chance of an outbreak as fertilizers run-off increases nutrient levels in coastal waterways.
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	H This is a naturally occurring organism. See Ecological TWG report for details.

Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	Burkholder, J.M. 1998. Implication of harmful microalgae and heterotrophic dingoflagellates in management of sustainable marine fisheries. Ecological Applications. 8(1): S37-S62. Glasgow H. B. Jr.; Burkholder J. M.; Schmechel D. E.; Tester P. A.; Rublee P. A. Dep. 1995. Insidious effects of a toxic estuarine dinoflagellate on fish survival and human health. Journal of Toxicology and Environmental Health 46(4): 501-522. Lansford, N.H. and Jones, L., 1995, Recreational & aesthetic value of water using hedonic price analysis, Journal of Agricultural and Resource Economics. 20(2):341-355. New Jersey Department of Health and Senior Services. 2000. Pfiesteria: Background Information and Contingency Plan. Surveillance for Possible Estuary-Associated Syndrome - Six States, 1998-1999. Morbidity & Mortality Weekly Report. May 2000. vol. 49, no. 17, pp. 372-373. Web sites given in text.
Current Policy and Regulatory Framework	
Federal	None
State & Local	None

Issue: Pfiesteria
Author: John Posey
Version: 12/14/00

Pfiesteria is a type of algae known as a toxic dinoflagellate. It lives in brackish and coastal waters and is naturally found in New Jersey. Most of its complex life cycle is spent in a harmless, non-toxic state. Pfiesteria becomes predatory and releases two to three toxins into the water for periods lasting only a few hours.
The toxins released by Pfiesteria can have serious human health effects, including lesions, respiratory distress, stomach cramping, behavior changes, erratic heart beat, and memory loss. Most of these symptoms are reversible. The Human Health TWG has not yet done an analysis for Pfiesteria.
There are significant ecological impacts to fish, which die when they come into contract with the toxins. See Ecological TWG report for full details.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	1	1	1	1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	1	1	1	1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
1	**1.2**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	2	2	2	1	3	2

Trend: -

Catastrophic Potential: L

Issue: Phosphorus
Author: John Posey
Version: 01/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Phosphorus** (Eutrophication due to elevated freshwater phosphorus levels.)
Description of stressor	Fertilizers are the major source of phosphorus in the environment. Agricultural runoff creates elevated phosphorus/phosphate levels in freshwaters. Residential fertilizers also contribute.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Elevated phosphorus levels in lakes leads to eutrophication, the state in which too much food exists for plants and algae. This excess supply of nutrients can alter the ecological balance in lakes.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	1) There is some evidence that eutrophication can reduce lakefront property values. 2) Eutrophication of lakes can decrease their recreational value. This may have a negative impact on employment. 3) The alteration of biodiversity may be considered an aesthetic impact. 4) Eutrophication can diminish the amount of enjoyment (utility) derived from a lake; this may be reckoned as an economic cost.
Key impacts selected (critical socio-economic effects)	Costs incurred, employment, aesthetics, property values.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Agricultural runoff leads to elevated phosphorus levels in lakes.
Quantification of exposure levels statewide	EQTWG finds that 100 lakes in the state are experiencing some degree of eutrophication.
Specific socio-economic entities at increased risk	This appears to be a statewide phenomenon. I was unable to determine the number of eutrophied lakes, or lake acreage, in each county.
Quantification of exposure levels to entities at increased risk	Same as statewide.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	Estimates based on hedonic and contingent valuation (willingness to pay) methods.

Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: Eutrophication could potentially have an effect on lakefront properties. A 1996 study by Michael, Boyle and Bouchard analyzes the effect of water clarity on lakefront property values. The authors used hedonic regression analysis. The data covered sales of lakefront properties in Maine from 1990-94. They concluded that an additional meter of visibility in a lake could increase the value of lakefront properties by 10-15%. Property value increases ranged from $34 to $620 per meter of shoreline frontage. NJCRP guidelines call for a score of "2" to be given to all impacts that reduce property values by more than 0.42%, with a score of "3" given to any impacts greater than 4.2%. It appears that eutrophication can have an effect on lakefront property values. However, the vast majority of properties in NJ do not enjoy shoreline frontage. If eutrophication reduces lakefront property values by 15%, then lakefront properties would have to represent 28% of all NJ property values in order to justify a score of "3." This clearly is not the case. However, in order to justify a score of "2," lakefront properties would only have to represent 2.8% of all property values in the state. It is highly unlikely that lakefront properties represent 2.8% of all residential property values statewide. However, there may be some regions in which lakefront property values rise above 2.8% of total property values. In these areas, it is possible that eutrophication would have a moderate impact on property values. Even in these areas, however, it is unlikely that the effects of eutrophication would be great enough to be given a score of "2" on a countywide level. I conclude that the effect of eutrophication on property values, then, merits a score of "1" statewide. However, the impact on owners of residential properties should not be minimized.	*1*
	Duration/irreversibility:	1
	Scale:	3
	Uncertainty:	2
Employment	Severity: Eutrophication could potentially affect jobs in the tourism, recreation and related sectors. There is little available evidence to guide an effort at estimating the employment impact of eutrophication. NJCRP guidelines call for a score of "2" to be given to any impact which affects more than 20,000 jobs. In order to test the hypothesis that eutrophication destroys more than 20,000 jobs, I propose to use a method of "deliberate overestimation." At each juncture in the calculations, I will use the most pessimistic estimate of impact on jobs. This will allow a judgment as to whether eutrophication could potentially affect anything close to 20,000 jobs. First, to estimate the number of lake swimmers in NJ, I use attendance statistics at state parks at which lake swimming and boating is offered. According to the State Park Service, the attendance at these parks is as follows:	1

PARK	ATTENDANCE
BELLEPLAIN	274,724
PARVIN	185,621
WHARTON	1,191,789
HOPATCONG	344,303
ROUND VALLEY	197,384
SPRUCE RUN	584,141
HIGH POINT	257,482
RINGWOOD	499,768
STOKES	521,314
SWARTSWOOD	161,523
WAWAYANDA	94,921
CHEESEQUAKE	439,609
TOTAL	4,752,579

The second step is to estimate the number of swimmers that might be deterred by eutrophication. It is important to realize that swimming and boating are not the only activities offered at these parks. Hiking, biking, camping, and skiing are also popular activities. It is also important to recognize that eutrophication will not deter all swimmers, particularly if algae growth is fairly moderate. I would consider it highly unlikely that eutrophication currently depresses attendance at these parks by as much as 25%. Thus, I use 25% as the base figure for future calculations.

Third, to estimate the number of swimmers and boaters deterred by eutrophication, I multiply the attendance figure by 25%. This leads to an estimate of 4,752,579 * 0.25 = 1,188,145 persons who do not pursue lake recreation because of eutrophication.

Third, it is necessary to estimate how much the average lake swimmer spends. There are several categories of spending. Day-trippers may spend money in nearby towns on gasoline, food, certain retail activities, and possibly lodging. However, many swimmers will spend nothing. They may take their food with them, and decline to visit stores located near the parks.

Overall, I would find it unrealistic to believe that local economies enjoy a benefit of more than $20 for every man, woman and child who visits a lake for recreation.

Fourth, I multiply the number of persons deterred from recreating by the amount of money spent per person: 1,188,145 * $20 = $23.76 million.

Fifth, I assume that each $50,000 (split between labor and capital) spent will support one fulltime job.

	O Sixth, divide the total amount not spent by recreators by the spending required to support 1 job: $23.76 million * 1 job/$50,000 = 475 jobs. This is far less than the 20,000 required to merit a score of "2" in this category, and it is likely that this pessimistic estimate actually overestimates the actual employment impact. Even if my calculations are off by an order of magnitude, the result is still far less than 20,000 jobs. I conclude that it is highly unlikely that eutrophication affects anything close to 20,000 jobs. _____ a) Duration/irreversibility:	_____ 1
	b) Scale:	3
	c) Uncertainty:	2
Costs Incurred	a) Severity: A literature review by the United Nations Environmental Programme does not identify direct costs, but only a loss of amenity values because of eutrophication, as discussed below. Direct costs are likely to be minimal.	1
	b) Duration/irreversibility	1
	c) Scale: Eutrophication is a statewide phenomenon.	3
	a) Uncertainty:	3
Aesthetic Levels	Severity: The loss of clarity in lakes, and negative impacts on the ecological balance of lakes, may reasonably be considered a moderate aesthetic impact. Studies by Michael, Bockstael and Needelman, described below, lend credence to this assessment. A literature review by the United Nations Environmental Programme discusses two studies that deal with costs of eutrophication. These studies attempt to quantify the value of the amenities lost because of eutrophication. These studies begin with the assumption that the clarity of lakes is a public good, and then attempt to estimate the value, in dollars, of this good. Needelman et al. use a discrete choice model to estimate the cost of eutrophication in New Hampshire lakes. Studies using discrete choice models typically employ surveys in which respondents are asked to choose between a series of paired alternatives. In this way, the economist attempts to estimate the shape of a utility curve. Needelman found that eutrophication reduced the enjoyment of swimming in NH lakes, and that this loss of utility amounted to $1.42 for each adult in the state on NH. Multiplied by the adult population of NH, this figure amounted to a total loss of utility of approximately $1.16 million. The population of NJ is about 8 times greater than the population of NH. Thus, if Needelman's conclusions are applied to NJ, then the value of the utility lost would amount to approximately $1.16 million * 8 = $9 million. The utility lost by boaters and fishers is not included in this estimate.	2

	Bockstael et al. use a contingent valuation method to estimate the cost of eutrophication in the Chesapeake Bay area. The authors conducted a willingness to pay survey of residents of the Baltimore-Washington MSA. The following scenario was evaluated: a 20% reduction in Nitrogen AND a 20% reduction in Phosphorus AND a 20% increase in the catch rate for bass fishers. Overall, the annual benefit estimates for such an improvement in water quality was in the range of $18 million to $55 million, with $40 million considered to be the "best guess." 97% of the value was due to improved conditions for swimmers and boaters, while the other 3% resulted from improvements for fishers. Unfortunately, the authors do not disaggregate the effects of reductions in phosphorus vs. nitrogen. If reductions in phosphorus are assumed to account for half of the estimated annual benefit, then the value estimate ranges from $9 million to $27.5 million, with $20 million as the "best guess." The Baltimore/Washington MSA, with a population of 7.3 million, is fairly close to the NJ population of 8.1 million. Thus, it is not unreasonable to assume that the Baltimore/Washington numbers are applicable to NJ. It is important to stress that these authors attempt to measure loss of utility, rather than actual out-of-pocket costs. Thus, this type of estimate is not usable in the "Costs Incurred" category under NJCRP guidelines. The studies reviewed here must be considered somewhat speculative, and applying the results to NJ adds another layer of speculation. Still, I conclude that these studies demonstrate that the loss of amenities is significant, and may reasonably be considered greater than the $16 million threshold for moderate cost impacts under NJCRP guidelines. This bolsters the case that the aesthetic impact should also be considered moderate.	
	b) Duration/irreversibility: Eutrophication can be irreversible.	3
	c) Scale: Eutrophication is a statewide phenomenon.	3
	d) Uncertainty: I am moderately confident of my assessment.	2
Psychological Impacts	a) Severity: No impacts hypothesized	0.1
	b) Duration/irreversibility:	1
	c) Scale:	3
	d) Uncertainty:	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: Too little is known about the recreation habits and attitudes of NJ citizens. It would be useful to perform discrete choice and contingent valuation studies for the NJ population to determine whether water clarity significantly affects NJ recreation choices.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0	
Potential for catastrophic impacts (H,M,L) and brief description	L	

Incidence of impacts (affected sub-groups, variability, equity issues)	n/a
Extent to which threat is currently regulated	See Federal and State regulations, below.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	L
Small business industry	L
Transportation	L
Residential	H: Fertilizer runoff and septic systems.
Agriculture	H: Fertilizer runoff and animal wastes.
Recreation	M: Golf courses
Resource extraction	L
Government	M: Sewage Treatment.
Natural sources/processes	M: Phosphorous occurs naturally in freshwater ecosystems.
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	H: Phosphates collect in lake sediments.
References	Bockstael, Nancy E., K. E. McConnell, and I. E. Strand Jr. "Measuring the Benefits of Improvements in Water Quality: The Chesapeake Bay." Marine Resource Economics 6 (1), 1989.

	Holly J. Michael, Kevin J. Boyle and Roy Bouchard. "Water Quality Affects Property Prices: A Case Study of Selected Maine Lakes." Maine Agricultural and Forest Experiment Station, University of Maine. Miscellaneous Report 398. February, 1996. Needelman, M., and M. J. Kealy, "Recreational Swimming Benefits of New Hampshire Lake Water Quality Policies: an Application of a Repeated Discrete Choice Model," *Agricultural and Research Economic Review* 24, 1995. New Jersey Department of Environmental Protection. "New Jersey Rule Proposals." *State Regulatory Alert*. July 3, 2000. New Jersey State Park Service. Attendance Report, Fiscal Year 1999. United Nations Environmental Programme. "Planning and Management of Lakes and Reservoirs: An Integrated Approach to Eutrophication." 1999. U. S. Census Bureau. State and MSA Population Estimates, 1999. U.S. Environmental Protection Agency. "Nutrient Criteria Development; Notice of Nutrient Criteria Technical Guidance Manual: Rivers and Streams." *Federal Register*. July 27, 2000.
Current Policy and Regulatory Framework	
Federal	The President's Clean Water Action Plan was presented on March 24, 1998. The Plan states that EPA will establish recommended water quality criteria for nutrients that reflect the different types of water bodies and different ecoregions of the country and that will assist the States and Tribes in adopting numeric water quality standards for nutrients. Consistent with the objectives of the Clean Water Action Plan, the U.S. EPA presented a National Strategy for the Development of Regional Nutrient Criteria on June 25, 1998. The major focus of the strategy is the development of waterbody-type technical guidance and recommended ecoregion-specific nutrient criteria by the year 2000.
State & Local	The Water Quality Planning Act was enacted in 1977. It mandates that the Department of Environmental Protection conduct the planning processes required by the Federal Clean Water Act, and that it establish a continuing planning process to encourage areawide planning and coordinate planning efforts to achieve water quality objectives statewide. DEP monitors nutrient levels in NJ lakes and determines which lakes should be classified as eutrophic or mesotrophic. Currently, 3 lakes are considered mesotrophic, and 113 are classified as eutrophic.

Issue: Phosphorus
Author: John Posey
Version: 01/01

Phosphorus: Elevated levels of phosphorus result primarily from agricultural runoff. Eutrophication of lakes is the biggest problem caused by phosphorous. "Eutrophication" refers to an overabundance of nutrients, which results in population explosions among certain types of plants and algaes. This has the potential to affect species distributions within lakes. Current levels of eutrophication are rarely severe enough to affect recreational use or employment. However, eutrophication may reasonably be considered a moderate aesthetic impact. In addition, the presence of clear lakes may be considered a public good. Studies have attempted to estimate the dollar value of the utility lost because of eutrophication. Although these studies are somewhat speculative in nature, they indicate that it is reasonable to believe that the value of the degradation of the public good may be greater than $16 million in NJ.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	1	2	0.1
Duration/ Irreversibility	1	1	1	3	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	3	3	3	18	0.3

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
5.46	**5.46**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	2	2	3	2	1	2

Trend: 0

Catastrophic Potential: L

Issue: Polychlorinated Biphenyls
Author: John Posey
Version: 01/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessement

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Polychlorinated Biphenyls (PCBs)**
Description of stressor	The following description comes from the EPA (2000): Polychlorinated biphenyls (PCBs) are synthetic chemical compounds consisting of chlorine, carbon and hydrogen. First synthesized in 1881, PCBs are relatively fire-resistant, very stable, do not conduct electricity, and have low volatility at normal temperatures. These and other properties have made them desirable components in a wide range of industrial and consumer products. …Commercial production of PCBs began in the US in 1929 in response to the electrical industry's need for a safer cooling and insulating fluid for industrial transformers and capacitors; this has been the major use for PCBs in North America. Until other uses were banned in 1977 and 1980, PCBs were also used as hydraulic fluids, as surface coatings for carbonless copy paper, as plasticizers in sealants, and as flame-retardants in lubricating oils. Until North American manufacturing of PCBs was banned in 1977, the Monsanto Company produced all of the PCBs used in the United States.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	PCBs are human carcinogens. PCBs in the environment are associated with deformity and mortality in birds and fish.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	The principal impact assessed here is the cost of illnesses associated with PCBs. It is more difficult to quantify impacts on job losses or property values.
Key impacts selected (critical socio-economic effects)	Employment, property values, costs incurred, aesthetic impact, psychological impact.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Persons can be exposed to PCBs through ingestion or inhalation. The principal source of PCBs in the environment today is runoff from contaminated sites. The dredging of contaminated sediments can also cause environmental exposure.
Quantification of exposure levels statewide	HHTWG indicates that data on PCB blood levels in NJ is not available. Statewide, there are currently 45 sites on the National Priorities List that are known to contain PCBs.
Specific socio-economic entities at increased risk	Gloucester, Middlesex and Somerset Counties appear to have the greatest number of sites containing PCBs. Persons who consume fish from the Hudson River are at greater than average risk, although it is impossible to quantify the differential in risk.
Quantification of exposure levels to entities at	The following table shows the number of NPL sites containing PCBs by county. While this is probably not a comprehensive list, it gives a sense of the relative number of PCB sites among the counties:

increased risk	Atlantic: 1 Mercer: 0 Bergen: 4 Middlesex: 8 Burlington: 4 Monmouth: 2 Camden: 1 Morris: 2 Cape May: 0 Ocean: 2 Cumberland: 1 Passaic: 0 Essex: 1 Salem: 0 Gloucester: 5 Somerset: 5 Hudson: 2 Sussex: 0 Hunterdon: 1 Union: 1 Warren: 0	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	I rely on cost-of-illness data from the National Institutes of Health to determine the economic impact of diseases identified by HHTWG.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk	Severity: Although scholars in the field of real estate appraisal have devoted some attention to the impact of contamination in general, little attention has been devoted to the specific impact of PCBs on property values.	Score
Property Values	Regarding the general impact of contaminated sites, Greenberg et al. (2000) estimate that 10% of all towns in New Jersey have at least one brownfield that reduces property values up to ¼ mile away. Simons, Bowen and Sementelli (1999) estimate that residential properties within 300 feet of a leaking underground storage tank (LUST) suffer a 17% reduction in value, while commercial properties within 300 feet of a LUST lose 33% of their market value. Greenberg and Hughes (1993) report that 28% of assessors in towns with hazardous waste sites report that market values are reduced by at least 5% in the area within ¼ mile of the site. McClelland, Schulze and Hurd use a hedonic regression model to demonstrate that houses in an area around a landfill saw their values reduced by $10,000, or about 8%. Thus, there are various estimates of property value impacts for various types of brownfields. Estimates of property values lost because of proximity to brownfields included "greater than 5%", 8%, 17% and 33%. It is difficult to know how to apply this research to the specific problem of PCBs. First, as noted, there is little appraisal literature devoted specifically to the impact of PCBs. Second, there is no firm count of the number of sites with PCBs in NJ. Third, sites with PCBs generally contain other harmful chemicals as well. There is little guidance available for separating out the effect of PCBs, as opposed to other nearby chemicals.	1

	Recognizing the difficulty of isolating the effects of different chemicals on property values, SETWG has elected to produce a writeup on the topic of brownfields in general. To avoid double-counting, the effects of PCBs will be registered in the current writeup with a score of "1." It should be remembered, however, that PCBs potentially contribute substantially to the impact of brownfields on property values.	
	Duration/irreversibility	2
	Scale	2
	Uncertainty	1
Employment	Severity: It is possible to hypothesize that PCBs could affect employment by contributing to a degradation of wildlife. Specifically, the effect of PCBs on fish and shellfish in the ocean could reduce the number of jobs available in the fishing industry. Today, PCBs enter the ocean environment primarily through the dumping of dredged material into the ocean. Sediments containing PCBs are regularly dredged from New York Harbor and the lower Hudson River. The dredging occurs to facilitate shipping. In recent years, the sediment dumping that has caused the most controversy has occurred in an area located 3-6 miles off of Sandy Hook. The EPA designated a 15-mile area of ocean bottom as a Historic Area Restoration Site (HARS). EPA regulates the amount of PCBs that can exist in sediment to be dumped in the HARS. The process for testing PCB levels in sediment is as follows: Sea creatures such as clams and worms are placed in sediments slated for dumping. The creatures live in the sediment for 4 weeks. At the end of this time, the sea life is measured to determine the amount of PCBs contained in the organisms. In this way, scientists can test how fast PCBs are moving up the food chain. For several years, environmental advocates such as Clean Ocean Action have alleged that EPA standards were too lax, and permitted too much damage to be done to the environment. In September, 2000, the EPA tightened standards for PCB ocean dumping. The PCB level for worms was decreased from 400 parts per billion to 113 ppb. The level for clams remained at 100. Cindy Zipf of Clean Ocean Action estimates that in the three years preceding this action, over a million tons of mud were dumped that would not have met the new standard. There is little scientific data available to indicate how much the populations of commercially harvested fish and shellfish have been reduced by PCBs. Nor is there discussion in the economic literature concerning the effect that PCBs might have on the demand for fish and shellfish. In addition, it is difficult to isolate the effect that PCBs have on sea life, since sediments containing PCBs also contain high levels of other dangerous chemicals, including petroleum byproducts, volatile organic compounds, and PAH's. Because of this problem, any employment impacts due to PCBs will be discussed more fully in the writeup on Dredging. To avoid double counting, the employment impact of PCBs will be awarded a score of "1" in the present writeup.	*1*
	Duration/irreversibility	2
	Scale	2
	Uncertainty	1
Costs Incurred	Severity: HHTWG estimates that between 2000 and 2500 cases of cancer in NJ each year are caused by PCBs in the environment. NIH estimates that a case of cancer, on average, costs about $60,000 (see writeup on 1,3-Butadiene for more information on this cost-of-illness estimate). If these figures are correct, then medical costs caused by PCBs cost the NJ economy between $120 million and $150 million each year. NJCRP guidelines call for a score of "2" to be given to all impacts costing more than $16 million and more than $160 million.	*2*

	Duration/irreversibility: Since PCBs are unusually stable chemicals, they do not biodegrade. Hence, PCBs can remain in the environment for a long time. Remediation can occur, but it is very costly. Remediation of PCB tainted sediment in the lower Hudson is expected to cost more than $200 million. Remediation of PCB tainted sediment in the Passaic River is expected to cost more than $100 million. Because of the cost and difficulty of remediation, it is reasonable to consider this problem to be fairly long-lived.	2
	Scale: If Superfund sites are any indication, PCBs appear to be concentrated most in urban and industrialized counties.	2
	Uncertainty: I am moderately confident of these estimates.	2
Aesthetic Levels	Severity: PCBs have affected the ecosystems of rivers in NJ. The most serious impact has occurred in the lower Hudson. For decades, General Electric factories north of Albany dumped wastes with PCBs into the Hudson. Today, sediments in the Hudson are still tainted with PCBs. In 1998, the EPA reported that PCBs in the sediment continue to escape into the water, where the chemicals are ingested by fish. The Passaic river is also contaminated with PCBs and other toxic substances. Fish from the Hudson and the Passaic are considered too dangerous to eat. It is unlikely that these conditions cause measurable economic impacts. It is unlikely that commercial fishing enterprises would spring up if the waters were cleaned, and it is impossible to measure the amount of ecotourism that is lost because of these unclean rivers. The inability of these rivers to support edible fish may be considered a low aesthetic impact because of its invisibility.	*1*
	Duration/irreversibility: Remediation is possible, but costly.	2
	Scale: Not every river is contaminated with PCBs. But contaminated rivers flow through several counties.	2
	Uncertainty: I am moderately confident of these assessments.	2
Psychological Impacts	Severity: There is some evidence that the public is aware of, and frightened of, PCBs. A Lexis search revealed dozens of articles about PCBs in the past year. Citizens in numerous states have protested the presence of PCBs. Because of the general awareness of PCBs, I deem it reasonable to believe that there is a moderate amount of worry about the chemical.	*2*
	Duration/irreversibility: Clean up is possible, but costly.	2
	Scale: Worry is probably concentrated most in urban and industrial counties.	2
	Uncertainty: These assessments are fairly speculative.	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L: The health effects of PCBs are fairly well documented. Additional research on the impact of PCBs on property values would be helpful.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ Clean up is occurring, but it is expensive and difficult.	
Potential for catastrophic impacts (H,M,L) and brief description	L: Because of the ban on new production of PCBs, the impact of these chemicals will probably not increase.	

Incidence of impacts (affected sub-groups, variability, equity issues)	Poor persons in urban areas are more likely to live near sites contaminated with PCBs. Poor persons are also more likely to depend on fish from contaminated waters.
Extent to which threat is currently regulated	Over the last 20 years, US EPA has propounded numerous rules pertaining to PCBs. Some of the major rules are as follows: 1979: A final rule banned the manufacture, processing, distribution in commerce, and non-totally enclosed use of PCBs. It also reduced the minimum regulated PCB concentration from 500 ppm to 50 ppm. 1982: A final rule allowed the use of certain electrical equipment containing PCBs to continue under specified conditions, and prohibited the use of PCBs in transformers and electromagnets posing an exposure risk to food and feed. 1983: A final rule gave the Assistant Administrator the authority to approve PCB disposal facilities. 1984: A rule authorized the use of PCBs for certain activities related to microscopy and optical fluids. 1985: A rule required the registration of PCB transformers with fire departments. 1987: A rule established requirements for the cleanup of spills resulting in the release of material containing 50 ppm PCB or more. 1996-99: Several rules define proper disposal procedures.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	H
Small business industry	M
Transportation	L
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	L

Natural sources/processes	L
Orphan contaminated sites	H
Diffuse Sources	
Sediment sinks	H
Soil sinks	H
Non-local air sources incl. deposition	L
Biota sinks	M
References	US Department of Health and Human Services, National Institutes of Health. Disease-Specific Estimates of Direct and Indirect Costs of Illness and NIH Support, Fiscal Year 2000 Update. http://www1.od.nih.gov/osp/ospp/ecostudies/COIreportweb.htm US EPA. Summaries of Major PCB Federal Register Notices. November, 2000. www.epa.gov/opptintr/pcb/frsummary.htm US EPA. Superfund Hazardous Waste Site Database. Http://www.epa.gov/superfund/sites/query/advquery.htm Jeffrey Gold. "US Tightens Standards for PCB Ocean Dumping." Associated Press. September 29, 2000. Kristen Milligan. Testimony before the Subcommittee on Fisheries Conservation, Wildlife and Oceans, US House of Representatives. February 22, 2000. Clean Ocean Action. "Contaminated Sediments." October, 2000. www.cleanoceanaction.org Joel Stashenko. "Hudson River PCBs Not Stable, EPA Says." Associated Press. July 24, 1998. Sari Harrar. "At Last, Passaic River Cleanup Cost May Top $100 Million." *The Record of Northern New Jersey*. March 22, 1994.
Current Policy and Regulatory Framework	See regulation, above.

Issue: Polychlorinated Biphenyls
Author: John Posey
Version: 01/01

PCBs are a group of carcinogenic chemicals. Their use was banned in 1979. Formerly, they were widely used in the electrical industry, and as coolants in other industries. HHTWG estimates that PCBs cause more than 2500 cases of cancer in NJ each year. The economic cost of illnesses associated with PCBs probably exceeds $100 million. PCBs are also suspected endocrine disruptors; this issue is more fully discussed in the writeup on hormonally active agents. It is likely that PCBs reduce property values on parcels located near contaminated sites, but it is impossible to quantify this effect. (This issue is discussed at greater length in the brownfield writeup.) The dumping of sediments contaminated with PCBs has occurred off the NJ shore for many years. The practice of dumping this sediment could affect the populations of commercially harvested seafood, although this is also impossible to quantify with available evidence. (This issue is discussed at greater length in the writeup on dredging.) The impact of PCBs on river environments, most notably the Passaic and the Hudson, may be considered at least a moderate aesthetic impact. The general public seems aware and frightened of PCBs, which implies that it may be reasonable to believe that PCBs have moderate psychological impacts.

Socio-economic Impact Evaluation of Environmental Issue:

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	2	1	2
Duration/ Irreversibility	2	2	2	2	2
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	4	4	8	4	8

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
5.6	**5.6**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	2	2	3	1.8

Trend: +

Catastrophic Potential: L

Issue: Polycyclic Aromatic Hydrocarbons (PAHs)
Author: Branden Johnson
Version: 05/19/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework **Findings/Notes**

Hazard Identification	
Stressor	**Polycyclic Aromatic Hydrocarbons (PAHs)**
Description of stressor	This class of benzene compounds has thousands of members; those of particular environmental concern are either acutely toxic, or are carcinogenic, mutagenic, or teratogenic to many organisms. PAHs are ubiquitous in the environment due to both natural processes (forest fires, volcanic eruptions, microbial synthesis, etc.) and human activities (petroleum releases, motor vehicles, high-temperature combustion of organic matter, charcoal-broiling of food, etc.).
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	For ecological impacts, aquatic organisms can accumulate PAHs at varying rates, linked to liver tumors in fish, and among invertebrates inhibited reproduction, delayed larval emergence, and other effects. Much less information is available on terrestrial effects, but impacts on soil invertebrates are definite; reproductive effects occur among birds at high doses; acute toxicity appears absent among birds and mammals; little is known about effects on amphibians and reptiles. Toxic effects on plants are well-established, including repression of plant growth and seed germination. Aside from natural background sources, PAHs can contaminate soil by direct placement of hazardous waste, discharges or spills; and through presence of historic fill containing PAH residues; and water through point or nonpoint discharges from wastewater treatment plants; surface water runoff or direct discharge from contaminated property; discharge of groundwater to surface water or wetlands; leaching from contaminated fill; and petroleum spills. Atmospheric deposition can affect soil or waters, and thereby reach affected organisms. Benthic macroinvertebrates in surface waters, and the fish populations dependent upon them, are potentially at increased risk, as are plant and animal communities near historic fill. However, surface water data are extremely limited in NJ; PAHs in inland freshwaters were largely reported as "nondetected" in the few cases where data were available. PAH data for the Passaic River are certain, somewhat more uncertain for estuaries, and moderately to highly uncertain for other freshwaters (particularly the Upper Delaware watershed management area) and soils. The underlying ecological risk is expected to remain constant for the next 5-10 years. The Ecological analysis identified natural resource damage assessments (i.e., payments made to cover estimated damages due to oil spills, which would include damages due to non-PAH components of oil), as well as costs associated with source controls and remediation of contaminated sites, as potentially relevant to socioeconomic impact analysis. PAHs have low acute toxicity in humans, but have several potential chronic effects. Skin, bladder, lung and possibly gastrointestinal cancers are the most significant of these effects (which tend to occur only from large PAHs, with four or more fused rings), but others include eye irritation, respiratory tract irritation (with cough and bronchitis), various skin effects (dermal burns, photosensitivity, etc.) and mild hepatoxicity and nephrotoxicity. Inhalation can occur both indoors (e.g., from tobacco smoking, unvented space heaters, food preparation) and outdoors (e.g., power generation, refuse burning, forest fires), and is a major route of exposure particularly for smokers and workers. Oral ingestion from food is a major route for non-smokers, from biosynthesis, adsorption of particulates deposited on plants from the atmosphere, and processing or cooking of food. Dermal exposure is usually a minor exposure route, but can occur from use of coal tar treatments for dandruff or psoriasis, and occupational exposure (used motor oil, roofing tar). Although all New Jersey residents are exposed to PAHs, an individual's body burden can vary widely based on local emissions and lifestyle factors.
Stressor-specific impacts considered (including direct socio-economic impacts	Property Values; Employment; Costs Incurred; Aesthetic Levels; Psychological Impacts

and those caused by ecological and human health risks):	
Key impacts selected (critical socio-economic effects)	Property Values: PAH sources that are officially-designated "contaminated sites" (either Superfund or state-designated) or that might be nuisances (e.g., highly smoky factories or incineration activities) might have property value impacts. Employment: Possible loss of recreational fishing-related jobs. Costs Incurred: Natural resource damage assessments; medical costs. Aesthetic Levels: No significant impact; e.g., smoke from petroleum or other burning might be unpleasant to nearby residents, but not necessarily due mainly or primarily to the PAHs contained in the smoke. Psychological Impacts: Worry could arise from people living near hazardous waste or industrial sites (some of which include or release PAHs), or from anglers concerned about the possibility of reduced fish populations.
Exposure Assessment	
Socio-economic entities: exposure routes and pathways considered	Freshwater anglers (if smaller benthic macroinvertebrate populations occur, lowering fish populations); residents and property-owners near officially-designated "contaminated sites" or major emitters of PAHs
Quantification of exposure levels statewide	All ecosystems and humans in NJ are exposed to PAHs, but elevated levels are particularly likely in urban/industrial surface waters and soils. However, individual exposures are likely to be highly variable, beyond geographic variation, given that lifestyle choices also can affect exposures.
Specific socio-economic entities at increased risk	Freshwater anglers, and suppliers of goods and services they use, in those areas where fish populations have been reduced by drops in benthic macroinvertebrate populations; residents near hazardous waste sites and facilities (including motor vehicle routes) associated with fuel and other combustion.
Quantification of exposure levels to entities at increased risk	No data available.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	Since no one has done the studies needed to quantify socioeconomic impacts of PAHs, only two approaches are possible: (1) use of control costs as a willingness-to-pay surrogate for consumer surplus (i.e., people would not spend more money on controls than the value they receive from avoiding undesired impacts of invasive species); thus control costs provide a plausible minimum estimate of socio-economic impacts; (2) estimating the degree of impact that would be needed to move from one category to another (e.g., a minimum of 20,000 jobs lost in relevant economic sectors to shift from a Severity score of 1 to 2), and then determining whether that degree of impact on ecosystem resources is plausible. Unfortunately, the first option is only partly feasible: natural resource damage assessments by NJDEP for oil spills (which can include PAHs) are available, but site remediation or air pollution control costs in NJ cannot currently be allocated to specific chemical compounds or classes that one might or might not find at particular sites. So the second, sensitivity analysis approach (estimating the value needed to switch from one category to another), will be the focus here, but still requires certain assumptions (e.g., the proportion of jobs in an economic sector that might be related to issue-relevant impacts), and depends very heavily on the plausibility of the divisions between categories. Note in particular that the property value impact is imputed from (for example) the presence of a contaminated site that hypothetically contains PAHs among many other hazardous chemicals, not from the PAHs themselves.

Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	a) Severity—Hazardous waste sites or major combustion facilities appear to be the only sites/sources of PAHs that could pose property value impacts. However, this impact is attributable, in the case of the waste site, to the official designation of the site itself, which on average contains many other chemicals than PAHs themselves, and thus cannot be attributed entirely to PAHs. It is thus assumed, given the myriad chemicals involved at such sites, that any property value impacts from PAHs will constitute on average no more than a small proportion of the total impacts. This estimate is based on the assumption that for most, if not all, such sites in NJ the complete elimination of PAHs would not alter the sites' property value impacts absent the removal of the other hazardous chemicals on-site, and that PAHs are unlikely to occur at every such site. The 1997 Known Contaminated Sites list from NJDEP lists contaminated sites statewide (e.g., every community in Atlantic County). 1998 property values statewide in NJ were $518.3 billion. Assuming a 5% drop in property values near hazardous waste sites, and assuming this occurs in every one of NJ's communities, that would mean a drop of $25.9 billion if all properties in a community were affected. Since it is unlikely that all or even most properties in a community would be affected, except in the very smallest of communities, and that PAHs are not the only contaminant in hazardous waste sites, the total property value loss that can be attributed to them is likely to be below the threshold of $12.96 billion for assigning a Medium score (2). Greenburg and Hughes (1993:47, Table 1) surveyed tax assessors in all NJ municipalities (response rate 26%). Since 1980 the typical hazardous waste site has had "no impact" on property values, according to 66% of the assessors for properties within ¼ mile of the site, 86% for properties from ¼ to 1 mile, and 93% for properties from 1-3 miles from the site. By contrast, lowering of property values "a good deal" (more than 25%) occurred in the communities of 7% of assessors for properties within ¼ mile and from none of them for other properties; a lowering of "somewhat" (5-25%) was reported by 21%, 9% and 2% of the assessors for the three distances, respectively. These results suggest that the 5% assumption is not inappropriate. Adding in major (i.e., ones large enough to be noticed as sources by lay citizens) combustion sources of PAHs undoubtedly would greatly increase property value impacts. However, one would have to assume a 5% drop in fully 50% of the statewide property values to meet the threshold, or equivalent relationships (e.g., 10% drop in 25% of the total value) in order to assign a Medium (2) score, which still seems unrealistic.	1
	b) Irreversibility—Property value studies show that these values rebound once cleanup has been completed.	1
	c) Scale—Although these sites occur throughout the state, the property value impacts themselves are limited to properties in the immediate vicinity of the sites	1
	d) Uncertainty.	2
Employment	a) Severity—The primary impact, if any, is assumed to be in sales of fishing gear and services in parts of the state where fish populations might have declined due to lower benthic macroinvertebrate populations in fresh waters. However, it is unlikely that any such impacts would reach 20,000 jobs (the threshold of a Medium, or 2, score), given (1) that this would be 18% of the "amusement and recreation services" (38,000) and "hotels and other lodging places" (74,000) sectors combined, which seems highly implausible, and (2) the likelihood that any such employment effects would be highly localized.	1
	b) Irreversibility--These impacts are assumed to be temporary	1
	c) Scale—highly localized	1
	d) Uncertainty	2

Costs Incurred	a)	Severity—NJDEP's Office of Natural Resource Damages settled six natural damage cases in 1998 for a total of $1.6 million (Site Remediation Program Annual Report 1998). Such damages are assessed for oil spills and hazardous sites that affect natural resources. Even if we assume that all such damages are attributable to PAHs, it would take ten times as much to meet the threshold of $16 million for assigning a Medium score (2). The Health analysis did not estimate the number of cancers and other health impacts that might occur due to PAHs in New Jersey. Let us assume that the cost of $23,322 for each bladder cancer case is the maximum that any health effects would incur (from 1997 NJ in-patient hospital costs for "kidney, ureter and major bladder procedures for neoplasm"; for example, this is nearly twice the per capita figure for lung cancer, of $13,818 for "respiratory neoplasm"). On that assumption, there would need to be 617 such cases from PAHs in NJ each year for the total costs (medical in-patient plus natural damage costs) to exceed the threshold. The New Jersey State Cancer Registry (www.state.nj.us/health/cancer/njscr1b.htm) report "Cancer Incidence in New Jersey, 1993-1997" (March 2000) reports a total of 10,016 bladder cancer cases diagnosed in 1997. Tobacco smoke (which includes PAHs, as well as other substances) and polyaromatic amines are the only well-confirmed chemicals associated with bladder cancers, although other chemicals are suspected risk factors (www.cancernews.com/bladder1.htm); even if we assume that 80% of these NJ bladder cancer cases are associated with these two factors, that leaves a significant portion of bladder cancers unaccounted for (about 2,000) that might be due to PAHs (as well as other chemicals), and the greater per capita cost of bladder cancer (versus health effects) might well be offset by the out-patient medical costs not accounted for in the above calculations. Thus Severity is judged to be Medium, because the uncertainty does not allow high confidence that it is Low.	2
	b)	Irreversibility—Ecological costs are likely to have a negligible effect on individuals' standard of living. Medical costs might have a moderate impact over a year.	2
	c)	Scale— likely that effects will be localized, despite PAHs' statewide ubiquity, since socioeconomic effects of ecological impacts likely to be restricted to relatively high doses of PAHs.	1
	d)	Uncertainty	3
Aesthetic Levels—no significant impacts	a)	Severity	0.1
	b)	Irreversibility	1
	c)	Scale	1
	d)	Uncertainty	1
Psychological Impacts	a)	Severity—moderate worry likely for average New Jerseyan about hazardous waste sites' impact on family and community; for simplicity this score will be assigned on the presumed effect of "hazardous waste sites," even though PAHs are a small portion of all hazardous components of such waste across the state, because people are unlikely to discriminate their worry by individual chemicals; this approach will lead to gross double-counting of worry's severity across environmental issues, but is more straightforward than chemical-specific worry scores. Because the class of "waste sites" is likely to be the most high-profile source of PAHs (e.g., relative to factories), the scores in this and the following categories are based solely on such sites.	2
	b)	Irreversibility—worry appears to disappear slowly for those who lived in the neighborhood of a hazardous waste site before it was identified and remain there after it is remediated; however, people who move into such a neighborhood after cleanup tend to see the area as better than their previous neighborhood and not be worried; between old residents moving out of a contaminated area to avoid further worrying and new residents moving in after cleanup, the irreversibility of worry in this case is assumed to be moderate at worse.	2
	c)	Scale—hazardous waste sites occur statewide, but are assumed to have only very localized impacts on worry.	2
	d)	Uncertainty—evidence of generalized worry about hazardous waste sites is well-established.	1

Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description (data gaps; highlight significant data needs)	H: Quantification of ecological and health impacts, and their location, would immeasurably improve the certainty of this risk estimate. Obtaining better data on socioeconomic costs (e.g., what are the economic costs of losing angling opportunities) would be useful, but far less than being able, for example, to determine what the impacts on benthic macroinvertebrate populations are, and on fish populations, if any.
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, ---, where + is improvement) and brief description	0: given the ecological estimate of zero change in underlying risks, and the ubiquity of PAHs in the New Jersey environment, it is unlikely that there will be any significant change in its socioeconomic impacts for the foreseeable future.
Potential for catastrophic impacts (H,M,L) and brief description	L: given the low catastrophic potential for ecological and health impacts, it is highly unlikely that there will be catastrophic socioeconomic impacts.
Incidence of impacts (affected sub-groups, variability, equity issues)	Socio-economic impacts likely to be low and fleeting for most ecological categories, and ubiquitous (in no obvious pattern) across New Jersey for most health impacts, thus raising no variability or equity issues of note. Property value and worry impacts will be concentrated near hazardous waste sites and factories and other "obvious" PAH sources, but the evidence for equity problems in such cases is mixed.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	NOTE: These are edited to average differences in the Ecological and Health analyses.
Large business/industry	H: PAHs are by-products of combustion, and are present in industrial chemical wastes such as coal tar, petroleum refinery sludges, waste oils and fuels, and wood treating residues; heat and power generation; controlled refuse incineration.
Small business/industry	M
Transportation	H: internal combustion engines
Residential	M: open burning, smoking, char-broiling foods
Agriculture	M: uptake in food crops of PAHs from dry and wet deposition
Recreation	L
Resource extraction	L: (We consider petroleum refining as falling under the large business category)
Government	L
Natural resources	H: microbial synthesis, volcanic activity, forest fires, wood-burning stoves

Orphan contaminated sites	M/H
Diffuse Sources	
Sediment sinks	H: in areas of known contaminated waste sites and/or urban industrial areas
Soil sinks	H: in areas of petroleum spills; contaminated fill
Non-local air sources incl. deposition	H: 43,000 metric tons of PAHs discharged into atmosphere each year (Eisler, 1987)
Biota sinks	L: little evidence of food chain biomagnification
References	Eisler, R. 1986. Chromium hazards to fish, wildlife and invertebrates: A synoptic review. U.S. Department of the Interior, Fish and Wildlife Service. Biological Report 85 (1.11), Contaminant Hazard Reviews, Report No. 11. Greenberg, Michael and James Hughes. "Impact of hazardous waste sites on property value and land use: Tax assessors' appraisal." The Appraisal Journal. January 1993, pp. 42-51. Site Remediation Program Annual Report 1998 (www.state.nj.us/dep/srp/publications/annual_reports/1998/intro_5.htm)
Current Policy and Regulatory Framework	
Federal	See below
State & Local	Control of PAH discharges and the remediation of PAH-contaminated hazardous waste sites in New Jersey are regulated under the Industrial Site Recovery Act (ISRA), Spill Compensation and Control Act, Solid Waste Management Act (SWMA), Water Pollution Control Act (WPCA), Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by Superfund Amendments and Reauthorization Act of 2986 (CERCLA) and the Hazardous Site Discharge Remediation Act.

Issue: Polycyclic Aromatic Hydrocarbons (PAHs)
Author: Branden Johnson
Version: 05/19/00
Socio-economic Impact Evaluation of Environmental Issue A[1]:

Polycyclic Aromatic Hydrocarbons (PAH): This class of benzene compounds has thousands of members; those of particular environmental concern are either acutely toxic, or are carcinogenic, mutagenic, or teratogenic to many organisms. PAHs are ubiquitous in the environment due to both natural processes (forest fires, volcanic eruptions, microbial synthesis, etc.) and human activities (petroleum releases, motor vehicles, high-temperature combustion of organic matter, charcoal-broiling of food, etc.). The most serious socio-economic impact associated with PAHs is the economic costs of cancer.

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	1	2	0.1	2
Irreversibility	1	1	2	1	2
Scale	1	1	1	1	2
Subtotal Risk	1	1	4	0.1	8

Average Risk (0–5 years)	Average Risk (5 years plus)
2.82	**2.82**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty	2	2	3	1	1	1.8

Trend: 0

Catastrophic Potential: L

[1] Subtotal Risk = sum of the four factors; Total Risk is the sum of subtotal risk.

Issue: QPX (Parasite in Shellfish)
Author: John Posey
Version: 03/01

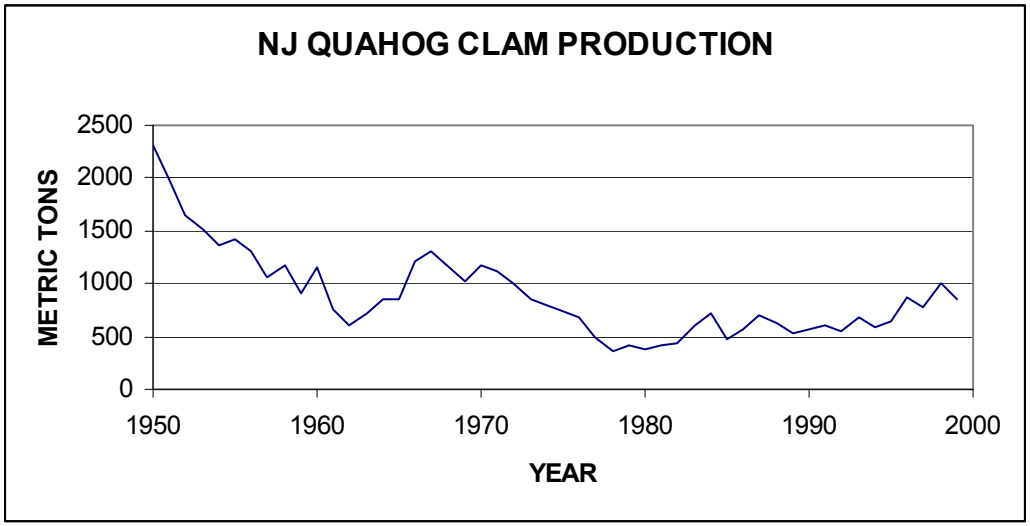
NJ Comparative Risk Project
Socio-Economic TWG
Stressor-Specific Risk Assessment

QPX (Parasite in Shellfish)

QPX is an abbreviation that stands for "Quahog Parasite Unknown." It was discovered in Massachusetts in 1995, but is thought to have existed before then. QPX kills mature quahog clams. It was discovered in NJ in 1997. QPX can affect both wild clam populations and seeded populations. QPX has badly damaged clam populations in the Provincetown area of Cape Cod. Thus far, it has not had severe effects on the NJ clam harvest.

There are three justifications for treating QPX in a short report. First, the EQTWG assessment concludes that although NJ ecosystems have been exposed, the ecosystem structure and function has been hardly affected.

The second justification is that there is not an observable downward trend in quahog harvests in NJ in recent years. The graph below shows annual harvests, 1950-99. Although there was a sharp reduction in harvest yields in the 1950s, there has been no strongly discernable trend since then. Since 1978, there has been a general upward trend in quahog harvests. Thus, evidence of a severe effect on NJ harvests does not yet exist.



Third, the dollar value of quahog harvests in 1999 was $7.36 million. If we assume that it takes at least $30,000 of production, split between labor and capital, to sustain one job, then quahog production accounts for at most 250 jobs. NJCRP guidelines consider any job loss of less than 20,000 to be a "low" impact. The loss of 250 jobs is a serious concern to those involved, and this impact should not be minimized. Thus, the impact score of "1" does not mean that this industry is unimportant. Finally, the loss of $7.36 million in output would be far less than the $16 million required for a "moderate" cost impact under NJCRP guidelines.

References:

U.S. Department of Commerce, National Marine Fisheries Service. Fisheries Dependent Data: Annual Landings. 2000.

Issue: QPX (Parasite in Shellfish)
Author: John Posey
Version: 03/01

Woods Hole Oceanographic Institute Sea Grant. "Shellfish Diseases and their Control in Local Waters." April, 1998.

Dick Russell. "ER Underwater." *Amicus Journal*, April 1, 1998.

Seth Rolbein. "Marine Mystery." *Boston Globe*, October 12, 1997.

QPX: QPX is a parasite that kills quahog clams. EQTWG reports that although there has been some exposure to QPX in Barnegat Bay, effects on the ecosystem thus far have been minimal. There is currently no evidence of a socio-economic impact associated with QPX. Quahog harvesting contributes about $7.36 million and about 250 jobs to the NJ economy.

Trend: -1 Catastrophic Potential: Low (1)

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	1	1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	1	1	0.1	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
0.46	**0.46**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	1	1	1	1

Trend: -

Catastrophic Potential: L

Issue: Radon and Radium
Author: John Posey
Version: 03/28/00

NJ Comparative Risk Project,
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework **Findings/Notes**

Hazard Identification		
Stressor	**Radon and Radium**	
Description of stressor	Radon-222 and its progeny (commonly referred to as radon) are naturally occurring gases created by the breakdown (decay) of uranium and radium in soil, rock and water. This radioactive gas is colorless, odorless and tasteless. It is found in outdoor air and water and can be concentrated in indoor air. Radium-226, Radium-228 and Radium-224 are naturally occurring radioactive elements produced during the breakdown (decay) of uranium and thorium. These metals are found in rocks, soil and water. Historically, radium has had a wide range of uses including watch and gauge painting, cancer treatment, and nuclear testing.	
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	The largest risks associated with radon and radium are human health related. The HHTWG has determined that lung cancer and stomach cancer are the two main risks traced to exposure of radon gases in the air and water. Numerous cancer types have been linked to radium, including bone sarcomas, cancers of the perinasal sinus and air cells of the head, and myeloid leukemia. Additional human health risks consist of cataracts, anemia, tooth and bone fractures, and general deterioration of bone tissue. This carcinogenic link to radon and radium leads to a number of socioeconomic impacts. Patients, their surviving families and insurance holders experience costs related to hospital care and death. The NJDEP estimates that there are approximately 500 lung cancer deaths attributed to radon each year. Mitigation costs for buildings (especially homes) that are classified as high exposure structures (4pCi/l or greater) are undertaken by homeowners. Because radon is natural and is present everywhere high exposure structures are scattered throughout the state, concentrations of buildings vary depending upon the region within the state. There remains to be limited amounts of detailed estimates of the number of individuals exposed to high concentrations of radium and deaths or illnesses directly linked to exposure. Since radon exposure is greatest in the home, the NJDEP has assigned a tier designation to each municipality and county in the 1996 Radon Tier Assignment Report. The designation of a municipality and county follows criteria based on the percentage of homes having radon concentrations greater than or equal to 4pCi/l. A tier designation list (Table 1) is provided for each municipality to determine the number of housing units at risk. This will be useful in determining potential health and mitigation costs to be assumed in New Jersey. Table 1 illustrates that there were	

	approximately 283,000 housing units potentially at risk (pCi/l levels equal to or greater than 4) in 1990. This was 9.2 percent of the total number of housing units listed for the state in the 1990 census. This number exceeds EPA estimates of 1 in 15 U.S. having elevated radon levels.	
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Value: Employment: Costs Incurred: Aesthetics: Worry:	
Key impacts selected (critical socio-economic effects)	Potential death associated with cancer attributed to radon, radium and their costs. Medical costs associated with nonfatal cancer attributed to radon and radium. Mitigation costs for structures and water systems having radon levels exceeding 4pCi/l. Remediation costs of radium contaminated sites.	
Exposure Assessment		
Socio-economic entities exposure routes and pathways considered	The major human exposure pathways of radon are inhalation of concentrated gas in indoor air and in air released from water sources and ingestion of the gas in drinking water. Costs associated with exposures to high levels of radon gas consist of medical and death costs, testing costs and in the case of above safe level concentrations in indoor air and groundwater, mitigation costs. The main human exposure pathways of radium are ingestion of water and food containing the element and skin contact. Similar to calcium, plants take up radium from the soil. Medical and death costs and contaminated site remediation costs are the two main socio-economic entities linked to radium.	
Quantification of exposure levels statewide	It is estimated that everyone breathes some level of radon. It is present in outdoor air. All individuals are exposed to some levels of the radium, as the element is moved through the food chain.	
Specific socio-economic entities at increased risk	Not applicable for radon since the gas is seen everywhere. Similar to radon, radium is found at some level in all soil. Higher concentrations of radon and radium are generally contained in the soil in specific geographic areas based on geography. These areas do not follow socioeconomic entities. Although, more affluent households have an increased means of affording radon testing and mitigation costs. Employees of firms that do / did use radium products are at higher risk than others. Also, residential areas closest to industrial zones have larger exposure risks than households some distance from radium-using firms. It should also be noted that there is a significant interaction effect between radon exposure and cigarette smoking. Smokers are probably at greater risk, though this is difficult to quantify.	
Quantification of exposure levels to entities at increased risk		

Dose/Impact-Response Assessment			
Quantitative/Qualitative impact-assessment employed	Current studies suggest that radiation exhibits a linear, no threshold dose-effect relationship.		
Risk Characterization			
Risk estimate(s) by socio-economic entities at risk		Radium Score	Radon Score
Property Values	Severity The ready availability of inexpensive mitigation processes in houses reduces or nullifies any impact on property value. In effect, homebuyers know that radon levels can be corrected with relative ease. The costs of testing for potentially high concentrations of radon and prior mitigation of such cases will usually be factored into the sales price of the house. The greatest exposures to high concentrations of radium are seen in older industrial areas. Remediation of soil will reduce radium concentrations to safe levels. Due to the site specific nature of contaminated parcels it has been determined that radium has little affect on property values throughout the state. The ability to remediate contaminated lands will eliminate any of the property value impacts associated with radium.	*1*	*1*
	Duration/irreversibility	1	1
	Scale	1	2
	Uncertainty	1	1
Employment	Severity The impact on employment appears to be insignificant.	0.1	0.1
	Duration/irreversibility	1	1
	Scale	1	2
	Uncertainty	1	1

Costs Incurred	Severity NIH data indicates that a typical case of cancer imposes economic costs of about $60,000, including direct medical costs, lost workdays, and lost productivity. (This does not include mortality costs, i.e., lost lifetime productivity of persons who die from cancer.) See Brown, 2001 and the writeup on 1,3-Butadiene for a more complete description of the cost of cancer. HHTWG estimates that **radon** accounts for more than 1436 cases of cancer in NJ each year. This includes lung cancer and stomach cancer. Lung cancer is the most common. If there are 1,436 cases each year, and if each case imposes costs of about $60,000 apiece, then the total cost of illnesses associated with radon adds up to about $86 million. HHTWG estimates that between 7-21 excess cancer deaths would occur in the population drinking water exceeding the combined **radium** MCL. If each case imposes a cost of $60,000 each, then the total cost of illness associated with radium adds up to $1.2 million. Even if 21 deaths is an underestimate, as the HHTWG states, the actual number of deaths attributable to radium would have to be 10 to 20 orders of magnitude larger to bump the score to "2". The second cost considered in this analysis deals with estimated mitigation costs for houses classified as potentially high risk. Table 2 shows that it is estimated that the approximate range of $141 million to $707 million would be the cost to mitigate all potentially high risk housing units in NJ (equal to or greater than 4pCi/l). If these costs were spread out over 10 years, then the annual cost would be $14 million to $70 million. Similar to radon, specific exposures to radium lead to two major costs. Despite the lack of necessary data, it is determined that the illnesses associated with radium result in costs related to health care and death. Recent remediation efforts in three Essex County municipalities have mitigated approximately 200 residential properties experiencing contamination linked to U.S. Radium Corporation in the City of Orange. These costs approach $175 million of federal and state monies. However, these are not ongoing costs. It is unlikely that remediation projects on this scale will occur every year. Moreover, federal funds used in cleanup projects may not be counted in this category under NJCRP guidelines. NJCRP guidelines call for a score of "2" to be given to costs ranging between $16 million and $160 million. Given the cost ranges cited above, it is most likely that the costs of radon and radium fall somewhere in this range.	*1*	*2*
	Duration/irreversibility	2	2
	Scale	1	2
	Uncertainty	1	2
Aesthetic Levels	Severity This colorless and odorless gas (radon) has no aesthetic impacts. Similarly, radium has no aesthetic impacts.	0.1	0.1
	Duration/irreversibility	1	1
	Scale	1	2

	Uncertainty	1	1
Psychological Impacts	Severity: There is little worry about these stressors. It rarely shows up in open-ended polling questions about environmental threats. A slight worry may be present when radon test levels exceed 4pCi/l, although easy and successful mitigation practices tend to dampen concern.	*1*	*1*
	Duration/irreversibility:	1	1
	Scale:	1	2
	Uncertainty	1	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	H: With better information the overall risk estimates may change in the future. Data Needs: estimates of non-fatal cancer patients attributed to radon and the cost of treatments estimates of fatal and non-fatal cancer patients attributed to radium and the cost of treatments better estimates and samples of houses (radon) and industrial sites (radium) at risk in the state estimates of the number of houses (or building) that have been mitigated / remediated sales prices of homes that were determined to have high levels and the number that have mitigated surveys of individual level of worry related to radon and radium estimates of work time lost due to illness caused by radon and radium		
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0: Radon and radium are naturally occurring elements that have always been present. Historically, radium has also been utilized for commercial and scientific purposes. The risks associated with the stressors are known and probably will not change. Increased data "may" show that radon and radium have larger or smaller risks than previously considered. This depends on further scientific study.		
Potential for catastrophic impacts (H,M,L) and brief description	L: It has been determined that the exposure does not and will not cause catastrophic impacts on the state as a whole.		
Incidence of impacts (affected sub-groups, variability, equity issues)			
Extent to which threat is currently regulated	There are currently proposed regulations for new home construction (mitigating technologies) in high risk areas and public water systems that have tested high for radon. Insurance companies also encourage homebuyers to have the sellers test for high concentrations of radon and mitigate if necessary before the sale of the home is completed. Sites contaminated with excess levels of radium are inventoried on the NJDEP's Known Contaminated Sites List. In addition, a number of sites contaminated with radium are contained on EPA's National Priority List (NPL).		
Relative Contributions of Sources to Risk (H,M,L); include any			

information/details on sources		
NJ Primary Sources		
Large business/industry	M Some businesses utilize / utilized uranium and radium for commercial and scientific uses.	
Small business industry	L	
Transportation	L	
Residential	L	
Agriculture	L	
Recreation	L	
Resource extraction	M	
Government	L	
Natural sources/processes	H These radioactive elements are naturally occurring.	
Orphan contaminated sites	H Radium contamination can be found in a number of orphaned industrial sites that are insecure.	
Diffuse Sources		
Sediment sinks	L	
Soil sinks	L	
Non-local air sources incl. Deposition	L	
Biota sinks	L	
References	HHTWG www1.od.nih.gov/osp/ospp/pdf/table_1.pdf www.epa.gov/iaq/radon/pubs/citguide.html www.epa.gov/iaq/radon/pubs/consguide.html www.epa.gov/iaq/radon/pubs/hmbyguid.html www.epa.gov/iaq/radon/pubs/physic.html www.epa.gov/iaq/radon/waterpres.html	

	www.epa.gov/iaq/radon/zonemap/zmapp31.htm www.epa.gov/iaq/construc.html www.epa.gov/docs/ieweb00/radon/index.html www.state.nj.us/dep/rpp/download/rawpack.pdf www.state.nj.us/dep/srp/publications/site_status/1998/html/98highli2.htm www.state.nj.us/dep/rpp/ber/radon/index.htm www.atsdr.cdc.gov/ToxProfiles/phs9022.html www.webelements.com/webelements/elements/text/Ra/key.html www.dnr.state.wi.us/org/water/dwg/radium.htm www.speclab.com/elements/radium.htm consumerlawpage.com/article/radon5.shtml www.nsc.org/ehc/radon.htm	
Current Policy and Regulatory Framework	Regulation decisions are allocated to states, education is done at all levels of government (EPA-federal, DEP-states, municipalities)	
Federal	Focus primarily on education outreach. The EPA provides numerous publications and undertakes studies focusing on radon.	
State & Local	New Jersey has proposed legislation that would regulate the amount of radon in drinking water and the levels of radon that are acceptable in new housing construction.	

Issue: Radon and Radium
Author: John Posey
Version: 03/28/00

Radon-222 and its progeny (commonly referred to as radon) are naturally occurring gases created by the breakdown (decay) of uranium and radium in soil, rock and water. This radioactive gas is colorless, odorless and tasteless. It is found in outdoor air and water and can be concentrated in indoor air.

Radium-226, Radium-228 and Radium-224 are naturally occurring radioactive elements produced during the breakdown (decay) of uranium and thorium. These metals are found in rocks, soil and water. Historically, radium has had a wide range of uses including watch and gauge painting, cancer treatment, and nuclear testing.

Socio-economic Impact Evaluation of Environmental Issue: Radon & Radium
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	0.1	2	0.1	1
Duration/ Irreversibility	1	1	2	1	1
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	2	0.2	8	0.2	2

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
2.48	**2.48**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty	1	1	2	1	1	1.2

Trend: 0

Catastrophic Potential: L

Socio-economic Impact Evaluation of Environmental Issue: Radon Only
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	0.1	2	0.1	1

Duration/ Irreversibility	1	1	2	1	1
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	2	0.2	8	0.2	2

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
2.48	**2.48**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty	1	1	2	1	1	1.2

Trend: 0

Catastrophic Potential: L

Socio-economic Impact Evaluation of Environmental Issue: Radium Only

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).

Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	0.1	1	0.1	1
Duration/ Irreversibility	1	1	2	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	0.1	2	0.1	1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
0.84	**0.84**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: L

Issue: Road Salt
Author: John Posey
Version: 03/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Road Salt**
Description of stressor	Road salt is used to melt ice and snow that accumulates on streets and highways in wintertime.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Runoff from streets and highways can damage nearby trees and shrubs. If the runoff reaches freshwater supplies, it can damage aquatic ecosystems. There have been isolated instances of salt contamination of drinking water in NJ in recent years. Finally, road salt can corrode electrical fixtures, causing threat of electrocution of animals.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values: Contamination of wells has been alleged to have caused a steep decline in property values, in isolated areas. Jobs: The contamination of streams and the resultant damage to aquatic life could threaten jobs in ecotourism. Costs: There are potential health costs related to contamination of drinking water. There may also be costs associated with the remediation of salt contamination. Finally, road salt corrodes cars. Aesthetic Impacts: Damage to roadside flora may be considered an aesthetic impact. Psychological Impact: Electrocution of beloved pets caused by salt corrosion could bring some psychological trauma.
Key impacts selected (critical socio-economic effects)	Property values, jobs, economic costs, aesthetic impacts, psychological impacts.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Road runoff is the mechanism for impacts associated with road salt.
Quantification of exposure levels statewide	Total amount of salt used each winter in NJ is unknown. However, each year on the Turnpike and Parkway, the Highway Department applies 400 pounds of salt per mile.
Specific socio-economic entities at increased risk	Communities dependent on well water.
Quantification of exposure levels to entities at increased risk	Difficult to estimate.
Dose/Impact-Response Assessment	

Issue: Road Salt
Author: John Posey
Version: 03/01

Assessment		
Quantitative/Qualitative impact-assessment employed	There are few state documents that assess the impact of road salt on health and the environment. Here, I rely on national reports for overview of potential damage, and upon news reports for information on damage in NJ.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: A small, isolated community in Northern NJ has complained of salt contamination of well water for several years. One disgruntled homeowner claims that salt contamination had made his home unsellable. However, efforts at affixing blame for the contamination have been unsuccessful. The residents filed suit against a paving company, whose rock salt supply was suspected to be the source of the contamination. However, the suit was dismissed. Although some residents speculate that road salt is the source of contamination, state officials have been unable to prove this assertion. Because of the isolated nature of this occurrence, and because causality remains unclear, I conclude that road salt has minimal impact on property values statewide.	*1*
	Duration/irreversibility	1
	Scale	1
	Uncertainty	1
Employment	Severity: It is possible that damage to aquatic life could reduce recreational fishing opportunities in NJ, and thereby threaten jobs in the ecotourism industry. A 1991 report by the National Academy of Sciences and a 2000 report by Environment Canada maintain that road salt runoff can cause damage to aquatic life. Rainbow trout, for example, are held to be especially sensitive to salt contamination. However, state officials quoted in news reports claim that there has been no documented occurrence of a fish kill caused by salt, and that salt levels in NJ freshwater remain below safety thresholds. I conclude that damage to employment has thus far been minimal.	*1*
	Duration/irreversibility	1
	Scale	1

	Uncertainty	1
Costs Incurred	Severity: There are several ways in which road salt could result in economic costs. First, salt runoff into the Oradell Reservoir in Bergen County has led to elevated salt levels in drinking water. The contamination has been extensive enough to make the water unsafe for persons with high blood pressure to drink. Although the contamination of drinking water could therefore lead to some medical costs, there is no evidence that this damage has been significant in NJ to date. Since HHTWG declined to produce a writeup on this topic, I conclude that health costs are probably minimal. In addition, it may be that contaminated well water may increase costs to homeowners affected. These individuals would be forced to purchase their own drinking water, or to invest in filtration devices. However, the cases of salt contamination have been so scattered that this is not likely to be a major source of economic costs in NJ.	1
	Third, the cost of fixing the environmental contamination in Bergen County has been estimated at approximately $300,000. This is the cost of installing water supply fixtures capable of bringing water from the public utility. Fourth, during harsh winters, the supply of road salt can be erratic. This sometimes leads to shortages and price gouging by salt manufacturers. While this is a headache for town managers, I am not convinced that it may properly be considered an environmental impact. Finally, Vitaliano (1992) estimates that road salt results in costs of more than $800 per ton ($1079/ton in 2001 dollars) associated with corrosion of roads, bridges, and motor vehicles. Total cost for NJ is about $1079/ton x 400 lbs./mile (0.2 ton/mile) x 35920 miles of major roads = $7.8 million. Combined, these cost are less than the $16 million required to justify a "moderate" impact rating under NJCRP guidelines. I conclude that costs associated with road salt in NJ are low.	
	Duration/irreversibility	1
	Scale	1
	Uncertainty	1
Aesthetic Levels	Severity: A 2000 report by Environment Canada found that salt can affect vegetation as far as 50 meters away from a roadway. The study further found that salt can make birds more susceptible to collisions with cars. A 1991 report by the National Academy of Sciences found that salt could damage nearby trees. Salt that accumulates in soil and water can poison sensitive trees, and salt on leaves and branches can reduce the robustness of the plant. The study found that airborne road salt could travel as far as 300 feet. Factors influencing damage to nearby flora include temperature, light, humidity, wind, soil texture, and precipitation. The Academy recommended the use of salt-tolerant plants near roadways, shallow ditches at roadside to divert runoff, and the use of non-salt de-icing substances. Deciduous trees were considered most sensitive to road salt. Coniferous trees are more salt-resistant. Clearly, salt can threaten certain types of roadside plants. Tree kills may be severe, but the damage is highly localized. Moreover, it appears that the problem is easily fixed by planting salt-resistant trees near roads. While damage to roadside plants may be considered an aesthetic impact, the damage caused by salt in NJ appears to be minimal.	*1*

	Duration/irreversibility	1
	Scale	1
	Uncertainty	1
Psychological Impacts	Severity: In New York, road salt has been blamed for the electrocution of dogs. Corrosion of electrical fixtures due to road salt was blamed for the death of one dog, and the serious electrocution of another in Manhattan. The psychological damage to the owners of these pets was probably non-trivial. However, this type of injury appears to be very rare, and the severity of psychological impacts can be categorized as insignificant.	*0.1*
	Duration/irreversibility:	1
	Scale:	1
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ As other de-icing chemicals are developed, reliance on rock salt should diminish. Alternatives to road salt include calcium magnesium acetate. These alternatives are more expensive than salt, but may be used effectively in environmentally sensitive areas. It should also be noted that some areas use sand rather than salt to increase traction on icy roads. Sand does not melt ice, however.	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	Communities reliant on well water.	
Extent to which threat is currently regulated	EPA has established a safety threshold of 250 milligrams per liter.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	L	
Small business industry	L	

Transportation	H
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	H
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	National Academy of Sciences, Transportation Research Board. Special Report 235: Comparing Salt and Calcium Magnesium Acetate for Highway Deicing. 1991. Environmental News Service. "Canada Finds Road Salt an Environmental Toxin." August 11, 2000. Jan Barry. "DEP Asks for Input on Water Quality Rules to Affect Six North Jersey Rivers." *Northern New Jersey Record*, 6/13/00. Jan Barry. "Salt in the Wounds: Well Seasoned Water Flap Irks Ringwood Residents." *Northern New Jersey Record*, 4/13/99. Jan Barry. "Salt Tainted Well Water Affects More than Pipes: Affordable Solution Sought in Ringwood." *Northern New Jersey Record*, 4/4/97. Jan Barry. "Salt Tainted Wells Pose Costly Problem: Pipeline Estimate Raised to $302,650." *Northern New Jersey Record*, 1/25/97. Michelle Han. "Speed the Plot: Removing Snow Puts Towns to the Test." *Northern New Jersey Record*, 1/4/01. Patrick Jenkins. "A Future for Barnegat Bay: Master Plan Nears Completion." *Newark Star Ledger*, 2/27/01. Danny Lee. "Unexpected Danger to Dogs Lurks on Snowy Streets." *New York Times*, 2/4/01.

	Richard McFadden. "Road Salt Supply Rocky for Towns." *Newark Star Ledger*, 2/6/01. Alex Nussbaum. "Clean Rivers Envisioned: New Initiatives Unveiled." *Northern New Jersey Record*, 12/6/00. Lawrence Ragonese. "Water Official Warns on Road Salt Overuse." *Newark Star Ledger*, 2/9/92. Donald Vitaliano. "An economic assessment of the social costs of highway salting and the efficiency of substituting a new de-icing material." *Journal of Policy Analysis and Management* 11(3): 397-418, Summer 1992. U.S. Department of Commerce, Bureau of the Census. *Statistical Abstract of the United States 2000*. Table 1014: Highway Mileage (by State). Downloaded on May 9, 2001 from http://www.census.gov/statab/www/
Current Policy and Regulatory Framework	
Federal	EPA has established a safety threshold of 250 milligrams per liter.
State & Local	Road salt in runoff has been included in local and regional plans in NJ. The Barnegat Bay watershed plan calls for monitoring about 70 substances, including road salt. In December 2000, Bergen County and the State unveiled a four-year campaign to cleanse the Hackensack and Hudson watersheds. Included in the plan is an effort to stanch the avalanche of road salt that has inundated the Oradell Reservoir in recent winters.

Road salt damages roads, bridges, vehicles, and roadside trees. It can also enter aquatic ecosystems via runoff, and threaten certain aquatic life. Finally, there have been isolated and unsubstantiated claims of road salt contamination of well water in NJ. However, all available evidence indicates that in NJ, these impacts have thus far been minimal.

Issue: Road Salt
Author: John Posey
Version: 03/01

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	1	1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	1	1	1	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
0.82	**0.82**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	1	1	1	1

Trend: +

Catastrophic Potential: L

Issue: Secondhand Tobacco Smoke
Author: John Posey
Version: 03/28/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Secondhand Tobacco Smoke (STS)**
Description of stressor	STS is a complex mix of chemicals generated during the burning and smoking of tobacco products. STS includes the emission from the burning end of the cigarette, cigar, or pipe as well as the exhaled mainstream smoke. All the compounds found in mainstream smoke, the smoke inhaled by the active smoker, are also found in "side stream" or secondhand tobacco smoke. Over 4,000 chemicals including 40 known or suspected human carcinogens have been identified in cigarette smoke. Chemicals present in STS include irritants and systemic toxicants such as hydrogen cyanide and sulfur dioxide; mutagens and carcinogens such as benzo (a) pyrene, formaldehyde, 4-aminobiphenyl; and the reproductive toxicants, nicotine, cadmium, and carbon monoxide.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	The Human Health Technical Work Group (HHTWG) reports that STS in NJ causes otitis media (infant ear infections), asthma, bronchitis and pneumonia, ischemic (coronary) heart disease, low birth weight, lung cancer, sudden infant death syndrome (SIDS), and lower respiratory tract infections. This writeup concentrates on the economic costs associated with these ailments.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	This writeup concentrates primarily on costs incurred as a result of STS related ailments. Aesthetic concerns are a secondary focus. No reliable evidence was available concerning the effect of STS on employment, property values, or worry.
Key impacts selected (critical socio-economic effects)	Costs incurred, aesthetic impacts.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	HHTWG reports the following: In New Jersey, exposure to STS occurs primarily in the residential, recreational, and school environments. It occurs to a lesser degree in the work environment due to regulations on smoking in the workplace. Exposure to the carcinogens in tobacco smoke occurs when side stream smoke is inhaled by the non-smoker into the lungs and breathing passageways of the body. It is then distributed to various sites in the body thereby contributing to carcinogenesis.
Quantification of exposure levels statewide	STS exposure occurs among all populations and ecosystems throughout New Jersey. The 1997 Behavioral Risk Factor Survey revealed that 21.3% of New Jersey adults, aged 18 and older, were current cigarette smokers. The 1996 data also reveal that the age group 18-24 had the highest percentage of usage with 29.6% reporting a positive smoking status. And, the most recent New Jersey Youth Tobacco Survey (1999) found that 14.6% of middle school students and 28.9% of high school students are current smokers.

	Additionally, the results of the 1999 Behavioral Risk Factor Survey reveal that 25% of smokers have reported smoking indoors in the past 30 days*. * These figures are based on unweighted raw data obtained from the 1999 survey-official results may differ from those reported here.	
Specific socio-economic entities at increased risk	STS affects persons of all socioeconomic backgrounds, though low-income individuals are more at risk than the affluent.	
Quantification of exposure levels to entities at increased risk	Same as statewide.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Costs associated with diseases are based on publicly available national estimates of costs per case.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: No discernible impact.	*0.1*
	Duration/irreversibility	1
	Scale	2
	Uncertainty	1
Employment	Severity: No discernible impact.	*0.1*
	Duration/irreversibility	1
	Scale	2
	Uncertainty	1
Costs Incurred	Severity: Costs associated with STS-related ailments are estimated at $186 million to $332 million. NJCRP guidelines call for a score of "3" to be given to all stressors associated with costs greater than $160 million. Following are disease-specific cost estimates. See end of document for calculation notes: Otitis Media: $5.4 million - $12.4 million Asthma: $4.5 million Bronchitis & Pneumonia: $4.6 million – 9.2 million Ischemic Heart Disease: $137 million - $243 million Low Birth Weight: $4.3 million - $8.2 million Lung Cancer: $5.4 million SIDS: No available information Acute LRI: No available information (Lower Respiratory Tract Infection)	*3*

	There are other potential costs related to indirect effects of cigarette. Though it is not possible to quantify the costs associated with these indirect effects, the potential costs are worth noting. First, Hassenzahl suggests that expenses stemming from litigation over past exposure in workplaces may be greater than current medical costs. However, since NJCRP guidelines preclude the inclusion of costs related to occupational exposure, this source of expenses will not be estimated in this report. Second, Brigham and McGuire (1995) report that fire from cigarettes kills more than 1000 people each year, and causes billions of dollars in damage. Although this source of costs is not directly related to the problem of secondhand smoke, it is nonetheless worth noting. (Peter Brigham and Andrew McGuire, 1995. Progress Towards a Fire-Safe Cigarette. *Journal of Public Health Policy* 16(4) p. 433ff.) Finally, the cost of cleansing cigarette-related odor from textiles may add to the total cost of cigarette smoke, although it is difficult to quantify the amount. See calculation notes at the end of this writeup for Cost of Illness information.	
	Duration/irreversibility: HHTWG reports the following: The health effects of exposure to STS vary widely. The overwhelming number of reportable effects are associated with reversible conditions and morbidity as a result of STS exposure is more widespread than mortality….Over half, (53%) of *all* affects (including lung cancer and death due to ischemic heart disease) manifests as middle ear infections, occurring mostly in children. Asthma exacerbation accounts for 33% of all affects. Bronchitis and Pneumonia, also treatable, account for 10% of STS related illness. Ischemic Heart disease which usually ends in death, accounts for the majority of morbidity associated with STS exposure, followed by deaths due to lung cancer.	2
	Scale: This is a statewide problem.	3
	Uncertainty: I am moderately confident of the estimates presented here.	2
Aesthetic Levels	Severity: While some persons are not bothered by tobacco smoke, others find passive smoke to be severely bothersome.	*2*
	Duration/irreversibility: The odor of cigarette smoke can linger in clothes and hair, even when a person in no longer near a cigarette smoker. However, individuals can voluntarily relocate themselves to avoid the worst effects of STS.	1
	Scale: Statewide.	3
	Uncertainty: I believe that this appraisal is reasonable.	2
Psychological Impacts	Severity: There has been much legal activity and moral persuasion aimed at reducing exposure to second-hand smoke, suggesting that there is at least a low level of residual concern about this issue.	*1*
	Duration/irreversibility:	1
	Scale:	2
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M,	M Estimates of costs associated with various diseases are based on national averages. It would be helpful to have additional information about the economic impacts of diseases specifically for the state of NJ.	

L) and brief description. (Data Gaps; highlight significant data needs)	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	++ Additional advertising efforts can, in the long term, educate smokers on the damage their smoke causes to others, especially children.
Potential for catastrophic impacts (H,M,L) and brief description	L. The only catastrophic scenario I can envision would be a class action lawsuit against NJ businesses that have sold cigarettes.
Incidence of impacts (affected sub-groups, variability, equity issues)	HHTWG reports the following: Children's lungs are even more susceptible to harmful affects from STS than those of adults. In infants and young children up to three years, exposure to STS causes an approximate doubling in the incidence of pneumonia, bronchitis, and bronchiolitis. There is also strong evidence of increased middle ear effusions, reduced lung function, and reduced lung growth. Several recent studies link STS with increased incidence and prevalence of asthma and increased severity of asthma symptoms in children of mothers who smoke heavily. These respiratory illnesses in childhood may contribute to small, but significant lung function reductions associated with exposure to STS in adults.
Extent to which threat is currently regulated	In the 1970's, New Jersey was a leader in restricting the non-smoker's exposure to STS. Current state laws only require that restaurants declare themselves to have a non-smoking section; it does not require a non-smoking section, nor does it require a separate ventilation system even if there is a non-smoking section. Current state laws also do not prohibit smoking in the workplace. Rather, it requires that employers with more than 50 employees have a smoking policy. It does not require any separation between smoking and non-smoking areas and although smoking in public places is prohibited, State laws do permit smoking areas under certain conditions. However, the results of the 1999 Behavioral Risk Factor Surveillance System show that 80.6% of respondents have a policy of No smoking in designated work areas with only 10% reporting some areas in which smoking is permitted and 6% with no official policy, while 2% have smoking in all work areas*. Most of the more recent restrictions on exposure to STS have occurred at the municipal level. Some have a complete ban on smoking, while others have banned smoking in public places that are frequented by children, others have bans on smoking in restaurants and workplaces[4]. Furthermore, commercial day care centers are required to be smoke-free.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	L

Small business industry	L
Transportation	L
Residential	H
Agriculture	L
Recreation	H
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	See calculation summary, below.
Current Policy and Regulatory Framework	See Regulation, above.
Federal	
State & Local	

Costs Associated with Secondhand Tobacco Smoke

Otitis Media: HHTWG estimates that STS causes 21,000 to 48,000 cases of Otitis Media (ear infection) in New Jersey each year. The National Institute of Health estimates that economic costs associated with Otitis Media amount to $5 billion each year. The Center for Disease Control reports that 19,309,000 cases of Otitis Media occurred in 1993. Using these figures, the cost per case is $5 billion/19.3 million =
$259 per case.

Using HHTWG estimates, then, the total cost of STS related Otitis Media in New Jersey is between:

21,000 * $259 = $5.4 million
48,000 * $259 = $12.4 million

Issue: Secondhand Tobacco Smoke
Author: John Posey
Version: 03/28/00
References:

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http://www.nih.gov/nidcd/health/pubs_hb/otitism.htm

Center for Disease Control. *National Ambulatory Medical Care Survey*. April, 1998.
http://www.cdc.gov/nchs/data/sr13_136.pdf

Asthma: HHTWG estimates that STS causes 240-780 new cases of asthma each year, and exacerbates 12,000 – 30,000 cases. The SETWG writeup on indoor asthma inducers reports estimates that there are slightly less than 800,000 asthmatics in NJ, and that medical costs associated with asthma in NJ are approximately $450 million. If all of these estimates are valid, then it appears that STS exacerbates (i.e., triggers asthma symptoms) in 1-4% of the asthmatic population. If STS is responsible for 1% of the costs of asthma, then the costs approximate $4.5 million.

References: "The High Costs of Asthma Care." *Allergy & Asthma Magazine*. September 18, 1997.
http://www.lungusa.org/press/medical/medacct.html

US Department of Health and Human Services, National Institutes of Health, Office of the Director. Disease-Specific Estimates of Direct and Indirect Costs of Illness and NIH Support. Fiscal Year 2000 Update.

Bronchitis & Pneumonia: The California Office of Environmental Health Hazard Assessment 1997 report, "Health Effects of Exposure to Environmental Tobacco Smoke,"" is the source of the HHTWG estimates of the number of medical cases caused by STS in NJ. This report indicates that there are between 7500 and 15,000 hospitalizations for bronchitis and pneumonia each year in the US that are attributable to STS. If NJ has a proportionate share of cases, then this would amount to between 225 and 450 hospitalizations. According to the Health Care Financing Administration (HCFA), the average bronchitis hospitalization in NJ incurred medical costs of about $20,374. (There were several times more bronchitis hospitalizations than pneumonia hospitalizations in NJ.) The cost of these hospitalizations, then, may be expected to run between $4.6 million and $9.2 million per year. This does not include the costs associated with the thousands of cases that did not result in hospitalization. Unfortunately, there is no firm estimate available for these non-hospital related costs.

Cost Estimate: $4.6 million to $9.2 million.

References: Samuel Louie, M.D. "Acute Bronchitis & Acute COPD Exacerbation." Winter, 2000.
http://medocs.ucdavis.edu/imd/420c/syllabus/acutbron.htm

U.S. Department of Health and Human Services, Health Care Financing Administration, Agency for Healthcare Research and Quality. HCUPnet, Healthcare Cost and Utilization Project. http://www.ahrq.gov/data/hcup/hcupnet.htm

State of California, Office of Environmental Health Hazard Assessment. Health Effects of Exposure to Environmental Tobacco Smoke. Final Report, 1997.
www.oehha.org/air/environmental_tobacco/leadets.html

Ischemic Heart Disease: HHTWG estimates that STS causes 1,050 – 1,860 deaths due to ischemic (coronary) heart disease each year. The American Heart Association reports that ischemic heart disease killed 459,841 Americans in 1998, and that the annual cost of the disease amounts to $60 billion. This figure includes health expenditures (direct costs, which include the cost of physicians and other professionals, hospital and nursing home services, the cost of medications, home health and other medical durables) and lost productivity resulting from morbidity (indirect costs). These estimates are consistent with National Institutes of Health estimates, which indicate that direct medical costs associated with ischemic heart disease amount to $53 billion, while indirect costs (including mortality, which is not included in NJCRP estimates) is over $40 billion. Using these

figures, ischemic heart disease costs approximately $130,000 per death. If these figures are correct, then the economic cost of STS-related ischemic heart disease in NJ each year is between:
1,050 * $130,000 = $137 million
1,860 * $130,000 = $243 million

It should be noted that "cost per death" is an artificial statistic. The total cost of a disease includes costs of both fatal and non-fatal diseases. In the "cost per death" statistic, then, an individual death serves as a proxy for a proportional number of non-fatal cases. Comparisons of cost per death among different diseases can therefore be misleading. Thus, this statistic should be seen as only as a computational aid.

References:

American Heart Association. "Economic Cost of Cardiovascular Diseases." 2000. www.americanheart.org/statistics/

American Heart Association. "Coronary Heart Disease and Angina Pectoris." 1999.
http://www.americanheart.org/statistics/04cornry.html

US Department of Health and Human Services, National Institutes of Health, Office of the Director. Disease-Specific Estimates of Direct and Indirect Costs of Illness and NIH Support. Fiscal Year 2000 Update.

Low Birth Weight: HHTWG estimates that STS causes 291-558 cases of low birth weight each year in NJ. Shiono and Behrman report that the incremental cost that low birth weights adds to infant care amounts to $4 billion each year in the U.S, and that 7% of babies born in the U.S. are considered low birth weight. CDC reports that there were 3,880,894 births in the U.S. in 1997. If 7% of these were low birth weight, then there were 271,663 low birthweight babies. Dividing these figures, the cost per case is approximately:
$4 billion / 271,663 = $14,724 per case.
Multiplying this amount by the range provided by HHTWG, the total cost in NJ is between:
291 * $14,724 = $4.3 million
558 * $14,724 = $8.2 million

References:

Center for Disease Control, National Center for Health Statistics. Statistical Tables on Births. 2000.
http://www.cdc.gov/nchs/about/major/natality/t2-1v97.pdf

Patricia Shiono and Richard Behrman. "Low Birth Weight: Analysis and Recommendations." *The Future of Children*, volume 5 number 1, Spring, 1995.

Lung Cancer: HHTWG estimates that STS causes 90 lung cancer deaths in NJ each year. NIH data indicates that an "average" case of cancer creates costs of about $60,000 (see writeup on 1,3-Butadiene). Using these figures, the total cost of STS-related lung cancer in NJ is about:

90 * $60,000 = $5.4 million

Reference: Deborah Marshall, Kit Simpson, Craig Earle and Chee-Wui Chu. "Health Economic Considerations in Evaluating Lung Cancer Screening." Presentation at the Second International Conference on Screening for Lung Cancer. February, 2000.
http://icscreen.med.cornell.edu/2CP/Marshall/sld001.htm

Issue: Secondhand Tobacco Smoke
Author: John Posey
Version: 03/28/00

SIDS: HHTWG reports 38-54 deaths from Sudden Infant Death Syndrome. I am unable to find any economic costs associated with these deaths, aside from funeral costs.

Acute LRI: HHTWG reports 3-6 deaths from lower respiratory tract infection each year. Since this is such a small number, I did not attempt to measure the economic impact of these deaths.

Total: Based on these estimates, the total economic cost of STS is between: $160 million and $282 million

Secondhand Tobacco Smoke (STS) is also known as passive smoke or secondary smoke. STS is associated with serious health problems, including lung cancer, coronary heart disease, and low birth weight. The economic cost of diseases associated with STS is estimated at upwards of $160 million.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	3	2	1
Duration/ Irreversibility	1	1	2	1	1
Scale (spatial, population)	2	2	3	3	2
Subtotal Risk	0.2	0.2	18	6	2

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
5.28	**5.28**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	2	2	1	1.4

Trend: ++

Catastrophic Potential: L

Issue: Starlings
Author: John Posey
Version: 10/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Starlings

The European Starling was introduced to North America 60 years ago. Since then, it has flourished in urban suburban environments. Nationwide, there are an estimated 200 million starlings. HHTWG declined to produce a writeup on starlings, indicating that the bird has minimal human health impacts. EQTWG produced a paragraph writeup, which concluded as follows: "Moreover, since a good deal of the success of this species is related to habitat conversion to suburban and urban landscapes that this species can tolerate, significant barriers exist to the potential restoration of natural conditions occurring prior to the introduction of this species. As a result, ecological risks from this species were not further evaluated in the NJ Comparative Risk program." A LEXIS search of NJ newspapers over the last five years revealed no discussion of negative consequences to human quality of life due to starlings. For all of these reasons, it is reasonable to conclude that starlings do not produce measurable socio-economic impacts in NJ.

Socio-economic Impact Evaluation of Environmental Issue:

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	0.1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	0.1	0.1	0.1	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
0.1	**0.1**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: L

John Posey, October 2000

Issue: Sulfur Oxides (Sox)
Author: John Posey
Version: 01/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Sulfur Oxides (S0x)**
Description of stressor	Sulfur dioxide (SO_2) belongs to the family of gases called sulfur oxides (SOx). Ambient sulfur dioxide results largely from stationary sources such as coal and oil combustion, steel mills, refineries, pulp and paper mills and from nonferrous smelters.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	The major health concerns associated with exposure to high concentrations of sulfur dioxide include effects on breathing, Respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. Children, the elderly, and people with asthma, cardiovascular disease or chronic lung disease (such as bronchitis or emphysema), are most susceptible to adverse health effects associated with exposure to SO_2. $S0_2$ is also a contributor to the problem of acid rain/acid deposition. However, this topic is covered in a separate writeup.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Human health impacts may lead to medical costs. Visibility impairment may be considered an aesthetic impact.
Key impacts selected (critical socio-economic effects)	Costs incurred, aesthetic impacts.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Health effects result from inhalation.
Quantification of exposure levels statewide	HHTWG reports the following: As a basis for comparison, the National Ambient Air Quality Standard (NAAQS) for sulfur dioxide under the federal Clean Air Act is 0.03 ppm as an annual arithmetic mean, 0.14 ppm as a 24 hour average, and 0.50 ppm as a 3 hour average. S0x is measured at 13 monitoring stations across the state covering 10 counties. The sites with the highest recorded ambient concentrations have average concentrations between 0.0044 and 0.0085 ppm, levels well below national standards. None of the sites have readings above 0.05 ppm more than 1% of the time.
Specific socio-economic entities at increased risk	HHTWG indicates that 5 counties showed hourly readings greater than 0.05 ppm during 2000. These were Camden, Gloucester, Morris, Union and Essex Counties.
Quantification of exposure levels to entities at	HHTWG reports the following in this category: "In the five counties with elevated S0x, there may be some reduction of a child's capacity to fight infection, although the low frequency of these exposures may suggest minimal incidence of these effects. The possibility for increased

levels to entities at increased risk	fight infection, although the low frequency of these exposures may suggest minimal incidence of these effects. The possibility for increased cases of respiratory disease suggested for concentrations between .01 and .05 is enhanced throughout the state, however the evidence drawing this conclusion is less certain than other epidemiological studies (NAPAP)"	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	N/A	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Aside from acid deposition, which is covered in a separate writeup, no impacts are hypothesized.	.01
	Duration/irreversibility	1
	Scale	1
	Confidence	1
Employment	Severity: No impacts hypothesized	.01
	Duration/irreversibility	1
	Scale	1
	Confidence	1
Costs Incurred	Severity: Ambient concentrations in all counties in NJ are well below NAAQS. Only 5 NJ counties recorded ambient concentrations in excess of .05 ppm for any 24-hour period in 2000. None of these counties recorded ambient concentrations greater than .05 ppm for more than 4 days in 2000. At levels greater than .05 ppm, there may be some risk of reduced ability to fight infection in children. There may also be a possibility of increased chances of respiratory disease, although HHTWG reports high levels of uncertainty. The levels of $S0_2$ reported in NJ are probably not high enough to trigger asthma attacks. Given the low statewide levels of $S0_2$, and the very sporadic nature of even moderately elevated readings (less than 1% of the time in 5 counties), it is unlikely that medical costs related to $S0_2$ exceed $16 million per year.	1
	Duration/irreversibility: Respiratory problems caused by sporadic peaks in S02 levels are probably fairly short-lived	1
	Scale: 5 counties in the state are at elevated risk	2
	Confidence: I am moderately confident of this assessment.	2
Aesthetic Levels	Severity: Using WTP methodology, Chestnut and Dennis estimate that a reduction in SO_2 emissions would result in improvements to visibility worth $2.3 billion to residents of the eastern U.S. The population of NJ is approximately 5% of the population east of the Mississippi. If NJ citizens enjoyed 5% of the $2.3 billion benefit, then the benefit to NJ would be worth over $100 million. It seems reasonable to consider this to be at least a moderate aesthetic impact.	2
	Duration/irreversibility:	2
	Scale:	3
	Confidence: I have moderate confidence in this assessment.	2
Psychological Impacts	Severity: No impacts hypothesized.	.1
	Duration/irreversibility:	1

	Scale:	1
	Confidence:	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	++ SO_2 emissions reductions have been significant in the first ten years of the Clean Air Act. EPA reports that emissions from the 263 highest-emitting units shrank from 8.7 million tons in 1990 to 4.8 million tons in 1997. Additional reductions are expected by the year 2010.	
Potential for catastrophic impacts (H,M,L) and brief description	L:	
Incidence of impacts (affected sub-groups, variability, equity issues)	Ambient concentrations cited above indicate that the most affected populations live in high density urban settings.	
Extent to which threat is currently regulated	Beginning in 1995, the EPA has operated a market-based allowance trading system. Under the system, regulated utilities are given a certain allowance that determines the amount of SO_2 the utility is allowed to emit. Utilities that reduce emissions to levels beneath their allowance may sell their excess allowances to non-complying utilities. Allowances are fully marketable commodities. Once allocated, allowances may be bought, sold, traded, or banked for use in future years. EPA claims that "the market-based allowance trading system capitalizes on the power of the marketplace to reduce SO_2 emissions cost-effectively and uses economic incentives to promote conservation and the development of innovative technology."	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	H	
Small business industry	L	
Transportation	L	
Residential	L	

Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	H
Biota sinks	L
References	Eugene Cerceo. "Acid precipitation and climate warming in southern New Jersey: Some global perspectives." American Environmental Laboratory. February, 1999. L.G. Chestnut and R.L. Dennis. "Economic Benefits of Improvements in Visibility: Acid Rain Provisions of the 1990 Clean Air Act Amendments." *Journal of the Air and Waste Management Association*, 47(3). 1997. James L. Regens. "Acid Deposition." *Keeping Pace with Science and Engineering"*, pp. 165-188. National Academy Press, 1993. Minnesota Pollution Control Agency. "Criteria Air Pollutant: Sulfur Dioxide (SO2) in Minnesota." 1997. Http://www.pca.state.mn.us/air/emissions/so2.html US EPA, Acid Rain Program. "Allowance Trading System Fact Sheet." November, 2000. Www.epa.gov/acidrain/allsys.html US EPA, Acid Rain Program. "Human Health Benefits from Sulfate Reduction Under Title IV of the 1990 Clean Air Act Amendments. November, 1995. www.epa.gov/acidrain/effects/healthx.html US EPA, Clean Air Market Program. "The Clean Air Markets Division." November 15, 1999. Www.epa.gov/airmarkets/transition.html US EPA, Clean Air Markets Program. "State Summary SO2 Emissions Data by Plant." Www.epa.gov/acidrain/emission/nj/nj_so2.htm US EPA, Office of Air and Radiation. "1997 National Air Quality Trends Brochure—Acid Rain." Www.epa.gov/oar/aqtrnd97/brochure/acidr.html

	US EPA, Office of Air and Radiation. "1997 National Air Quality: Status and Trends." Www.epa.gov/oar/aqtrnd97/brochure/so2.html US EPA, Office of Air and Radiation. "1997 National Air Quality Trends Brochure—Visibility." Www.epa.gov/oar/aqtrnd97/brochure/vis.html US EPA, Office of Air and Radiation. *Benefits and Costs of the Clean Air Act: Final Report to Congress on Benefits and Costs of the Clean Air Act, 1990 to 2010*. 1999. www.epa.gov/oar/sect812/ US EPA, Region 5. "Sulfur Dioxide." www.epa.gov/ARD-R5/naaqs/so2.htm
Current Policy and Regulatory Framework	
Federal	There are three National Ambient Air Quality Standards (NAAQS) for SO_2: an annual arithmetic mean of 0.03 ppm (80 ug/m3); a 24-hour level of 0.14 ppm (365 ug/m3); and a 3-hour level of 0.50 ppm (1300 ug/m3). The first two standards are primary (health-related) standards, while the 3-hour NAAQS is a secondary (welfare-related) standard. The annual mean standard is not to be exceeded, while the short-term standards are not to be exceeded more than once per year.
State & Local	

Issue: Sulfur Oxides (Sox)
Author: John Posey
Version: 01/01

Sulfur dioxide (SO_2) belongs to the family of gases called sulfur oxides (SO_x). Ambient sulfur dioxide results largely from stationary sources such as coal and oil combustion, steel mills, refineries, pulp and paper mills and from nonferrous smelters. The major health concerns associated with exposure to high concentrations of sulfur dioxide include effects on breathing, Respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. Children, the elderly, and people with asthma, cardiovascular disease or chronic lung disease (such as bronchitis or emphysema), are most susceptible to adverse health effects associated with exposure to SO_2. In addition, sulfur compounds in the air contribute to visibility impairment in large parts of the country. This is especially noticeable in national parks.

Ambient concentrations in NJ are well below the National Ambient Air Quality Standard (NAAQS). The assessment produced by the Human Health Technical Work Group indicates that very few respiratory illnesses in NJ are attributable to $S0_2$. It is therefore unlikely that health costs exceed $16 million. Published reports indicate that $S0_2$ does significantly detract from visibility in the eastern U.S. This may be considered a moderate aesthetic impact. Acid deposition is covered in a separate writeup.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	.1	.1	1	2	.1
Duration/ Irreversibility	1	1	1	2	1
Scale (spatial, population)	1	1	2	3	1
Subtotal Risk	.1	.1	2	12	.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
2.86	**2.86**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	2	2	1	1.4

Trend: ++
Catastrophic Potential: L

Issue: Thermal Pollution
Author: John Posey
Version: 11/00

New Jersey Comparative Risk Project
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Thermal Pollution
refers to elevated ambient surface water temperatures resulting from industrial discharges. Elevated water temperature may increase metabolic and respiration rates, altering behavior patterns (e.g., feeding and migration) of aquatic organisms. Although rising temperatures may enhance the growth rate of some organisms, eventually higher temperatures can adversely affect reproduction and survival. The extent of damage depends on the rate of temperature change, duration of the exposure, and where the ambient temperature lies in relation to the tolerance range of a given species. EQTWG concludes that "thermal modification currently does not represent a significant category of water quality impairments reported by New Jersey. We do not expect thermal pollution to pose greater ecological risk in the future given the stringency of permit requirements." Based upon this assessment, it appears that the socioeconomic impacts are minimal.

A reviewer offered the caveat that under drought conditions, thermal pollution could exert a higher toll. The flushing discharges of waterways tend to mitigate the impact of thermal pollution. Under severe drought conditions, the water-to-discharge could be low enough to allow thermal changes to exert an influence that is "higher than insignificant." However, it is difficult to demonstrate that measurable socio-economic consequences would occur. In light of this, and in light of the findings of the EQTWG, it still appears that impacts over the next five years are likely to be well below the thresholds required for a "moderate" impact under NJCRP guidelines.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	0.1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	0.1	0.1	0.1	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
0.1	**0.1**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	1	1	1	1

Trend: 0
Catastrophic Potential: L

Issue: Tin
Author: John Posey
Version: 07/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Tin

The following is taken from the *Handbook of Toxic and Hazardous Chemicals and Carcinogens*, 3rd edition, 1991:

"The most important use of tin is as a protective coating for other metals such as in the food and beverage canning industry, in roofing tiles, silverware, coated wire, household utensils, electronic components, and pistons. Common tin alloys are phosphor bronze, light brass, gun metal, high tensile brass, manganese bronze, die-casting alloys, bearing metals, type metal and pewter….Exposure to tin may occur in mining, smelting and refining, and in the production and use of tin alloys and solders. Inorganic tin compounds are important industrially in the production of ceramics, porcelain, enamel, glass, and inks; in the production of fungicides, anthelmintics, insecticides; as a stabilizer it is used in polyvinyl plastics and chlorinated rubber paints, and it is used in plating baths."

The federal government and several states have set standards for tin in ambient air. In the United States, there are no criteria set for permissible concentration in water. Systematic exposure to tin fumes can cause benign pneumoconiosis, although no evidence of disability has been linked to atmospheric tin exposure.

The following information was obtained from *The Dictionary of Substances and their Effects*, 2nd edition, 1999:

Studies have been conducted to determine the ecotoxicity of tin. No avian or mammalian mortality has been associated with elevated ingestion of tin. The only human health effects reported were nausea and diarrhea following the ingestion of highly acidic fruit punches stored in tinned vessels. Some studies have found negative effects of exposure to elevated levels in rainbow trout and invertebrates in the daphnia and gammarus genuses.

Evaluation:

There is little reason to believe that tin poses any significant threat to New Jersey. As the (admittedly biased) International Tin Research Institute argues, "more than 300 million tinplate cans of food are eaten daily. This is a powerful confirmation that tin is an essentially safe material." Regulatory authorities do not find it necessary to establish maximum tin levels in water, and inhaled tin results only in benign conditions. No mammalian or avian mortality has been reported. Thus, available evidence indicates that tin is a safe metal, unlikely to produce negative impacts with respect to employment, property values, aesthetics or worry.

A reviewer added the following comment: It is interesting to note that world tin mining/production is dominated by Brazil and China. However, world tin consumption is dominated by the US and Japan. Socio-economic risks of tin use are not a threat to NJ, but risks do exist for the Amazon region. NJ consumers contribute to these risks.

Issue: Tin
Author: John Posey
Version: 07/00

Tin is a naturally occurring element which is used in a variety of industries. About a third of all tin produced today is used for canning food. Tin is also used as a solder in electrical and plumbing applications, and alloys are used to create a variety of metal utensils. Tin levels in water are not regulated by the government. Inhalation of tin in occupational settings can have benign respiratory effects. Available evidence indicates that tin is a safe substance, not likely to have measurable negative economic or aesthetic impacts.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	0.1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	0.3	0.3	0.3

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
0.3	**0.3**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: L

Issue: Ultraviolet Radiation
Author: Kenneth Fung
Version: 12/14/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework **Findings/Notes**

Hazard Identification	
Stressor	**Ultraviolet Radiation**
Description of stressor	Ultraviolet (UV) Radiation is an electromagnetic energy produced by the sun. It has been divided (somewhat arbitrarily) into three categories: UVA, with wavelengths from 320-440 nanometers, UVB, with wavelengths from 280 –320 nanometers; and UVC, with wavelengths from 100-280 nanometers; UVA is not absorbed by the upper atmosphere's stratospheric ozone layer, but is considered less hazardous then UVB, which is mostly absorbed by the ozone layer. UVC is extremely hazardous, but at the present time it is completely absorbed by ozone and normal oxygen (O2). Most artificial sources of UV, except for lasers, emit a spectral continuum of UV containing characteristic peaks, troughs and lines. Examples of sources are mercury vapor lamps, fluorescent lights, germicidal lamps, black light lamps, plasma torches, open arcs and sunlamps used in the tanning salon industry. The intensity of UV Radiation can be determined by the UV index, which is the amount of UV Radiation expected to reach the earth's surface at the time when the sun is highest in the sky (noon time). The UV index ranges from 0 (nighttime) to 16 (in the tropics at high elevations under clear skies). Damage on skin and eyes may occur when the UV index is 10 or above. The ozone layer in the earth's atmosphere shields humans from most UV radiation. In recent years, scientists have documented an ongoing depletion, or thinning, of the ozone layer. Ozone depletion is linked to increases in UV radiation. Therefore, ozone depletion is expected to lead to an increase in skin cancer. Increased UV can also lead to reduced crop yield and disruptions in the marine food chain. Ozone depletion is caused by the release of chlorofluorocarbons (CFCs) and other ozone-depleting substances (ODS), which were used widely as refrigerants, insulating foams, and solvents. In the 1980s, the Antarctic "ozone hole" appeared and an international science assessment more strongly linked the release of CFCs and ozone depletion.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Excessive UV exposures will result in sunburn, skin cancer (Basal cell carcinoma, Squamous cell carcinoma and melanoma), premature aging of the skin, snow blindness and cataracts. It will also produce immune system deficiencies, which can lead to an eventual cause of skin cancer. UV Radiation can affect all natural ecosystems, particularly the primary productivity systems (e.g., phytoplankton), and their recovery period is extremely long even if it is possible. An increased level of UVB exerts effects more often through altered patterns of gene activity rather than damage. Moreover, environmental stabilization projects utilizing photosensitive materials may have a reduced efficiency or premature failure due to photodegradation.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values; Employment; Costs Incurred (Health related costs and the impacts to tourism industry); Aesthetic; and psychological impacts. UV Radiation can affect all of these impact items, though the response of the impact items to the stressor are varied.

Key impacts selected (critical socio-economic effects)	The impacts of the increasing level of UV Radiation are primarily on the ecological and health exposures to the stressor. Studies and research on the relationship between UV Radiation and socio-economic cost are inadequate, in fact the only impact items that are well-studied in terms of quantitative estimation is the cost incurred due to the medical issues, which is more directly contributed to the UV Radiation. Other kind of impact items, like the property values and tourism industry, are mainly based on this author's personal judgment.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	The primary source of UV radiation for the majority of humans is exposure to the sun. 50% of UV emitted by the sun that reaches the earth occurs between 11:00am and 2:00pm and so this is a critical window of exposure. New Jersey is located in the mid-latitude in which the UV index during the summertime is approximately 8-10. Generally low terrain in NJ does keep the UV level from becoming excessively high. Human exposure to UV Radiation is statewide. Thus the medical costs incurred due to the exposure to UV Radiation should be estimated on the state level as a whole, except it is possible that the coastal area with abundant tourism resorts are more likely to have larger number of people exposed to that stressor. Workers in the natural resource extraction industries like mining or oil drilling are at risk of exposure to very high levels of UV. Eye and skin protection is mandatory for workers, but caution must be taken to insure that accidental exposures to unprotected individuals in a work area do not occur.
Quantification of exposure levels statewide	Spatial: Major impact should be evenly distributed since the greatest group at risk are the tourists that tan on the coastal region—mostly mobile and is hard to determine their residence. Yet the population group working in the construction site may have the higher possibility of having high exposure due to their practice of arc welding. Temporal: Like global warming and ozone depletion, UV radiation is a problem that will gradually worsen over time, and the impacts could last a long period of time and it is very hard to reverse it in a short period.
Specific socio-economic entities at increased risk	Tourists flocking to the beach for tanning on the coastal regions during the summer months are the greatest groups of risk. Employees having long working hours in outdoors, are also vulnerable to exposure to UV Radiation.
Quantification of exposure levels to entities at increased risk	It is hard to quantify exposure levels. But the following items will be discussed. a. Economic loss on the tourism industry. b. Economic loss, if observable, on property values. c. Medical cost due to the increasing level of UV induces health problems, most notably skin cancer and eye problems.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	The impacts of UV Radiation to the society are varied due to the relationship between the nature of the stressor and the impacts. Only the cost incurred due to the UV Radiation is well documented, and thus its reliability is higher. The other kind of impacts is either negligible or not quantifiable, so the assessments on these impacts are based on the surveyor's assumptions and predictions on some possible outcomes.
Risk Characterization	

Risk estimate(s) by socio-economic entities at risk	Risk	Score
Property Values	Severity It is widely known that the increased level of UV Radiation is due to the depletion of stratospheric ozone layer, although the latter is also implicated in global climate change. I was not able to identify any research about the impact of UV Radiation on property values. It is speculated that the economic loss due to the dropping number of tourists to coastal areas may result in a drop of property values in these regions; such notion is not convincing. So far as we concerned, the impacts should be negligible.	0.1

	Duration/irreversibility The increasing risks of UV Radiation are a global issue, in which their impact is long lasting in terms of spatial and temporal scales. The possibility of reversibility is very low, at least in the near future. Since the impact of UV Radiation to the property is insignificant, however, and the possible impact is not even quantified in monetary terms, so this is hardly any noticeable or substantial consequence to last into future.	3
	Scale The impacts of UV Radiation are global. But given the small area of New Jersey, the UV intensity and its impacts should be more or less the same throughout the state. Same as the previous dimension, the impact of UV Radiation to the property is insignificant, and the possible impact is not even quantified in monetary terms, so this is hardly for us to determine the consequences in relation to scale of exposure. Hence this function is not applicable here.	3
	Uncertainty: I am fairly certain that UV will have a minimal impact on property values in NJ over the next 5 years.	1
Employment	Severity: If depletion of the ozone layer resulted in greatly increased risk of skin cancer, this could potentially affect beach tourism in NJ. However, there is no indication that demand for beach access is presently declining.	0.1
	b) Duration/irreversibility	3
	Scale	3
	Uncertainty: I am fairly confident that UV will have little impact on employment over the next 5 years.	1
Cost Incurred	Severity The major cause of health related problems due to excessive exposure of UV Radiation is skin cancer. Skin cancer can be divided as melanoma or non-melanoma (basal cell carcinoma and squamous cell carcinoma). Non-melanoma skin cancer have a much higher incidence rate, which estimated to be about 1.3 million cases nationwide in 1997, yet 95% of those are curable. Melanoma, a serious type of skin cancer, has a lower survival rate, but also a much lower incidence rate. There were about 41,600 cases of melanoma nationwide in 1997. The total treatment cost of melanoma and non-melanoma skin cancer is $1 billion and $1.13 billion annually. Based on 1100 incidence rate of melanoma skin cancer in New Jersey, the figure for the treatment of melanoma skin cancer should be about $26.4 million, which is based on the ratio of figure in New Jersey to the figure nationwide. The number of incidences of non-melanoma skin cancer in New Jersey is not available, but the best estimate should be about 35000 incidences (assuming the ratio of New Jersey to nationwide is the same with the ratio in the case of melanoma skin cancer) and the total cost should be $30 million. The United Nations Environment Programme has estimated that over 2 million non-melanoma skin cancers and 200,000 malignant melanomas occur globally each year. In the event of a 10% decrease in stratospheric ozone, with current trends and behavior, an additional 300,000 non-melanoma and 4500 melanoma skin cancers could be expected worldwide.	2

	There are 1.3 million incidences of cataract occurring each year nationwide, and removing cataract costs the nation about $3.5 billion. The figure of incidences in New Jersey is estimated to be about 38,430 and the cost of removal may be about $103 million. Since cataracts can be caused from a variety of other factors like aging, diabetes or the family history, roughly about 30% of those total causes may be related to the excessive exposure of UV Radiation. Based on this estimation, the figure in New Jersey should be about $31 million. Total medical costs associated with UV radiation in NJ, then, are approximately $80 million. NJCRP guidelines call for a score of "2" to be given to impacts between $16 million and $160 million.	
	Duration/irreversibility The increasing risks of UV Radiation are a global issue, in which their impact is long lasting in terms of spatial and temporal scales. The possibility of reversibility is very low, at least in the near future. In fact skin cancer is one of the fastest growing cancers in the nation.	3
	Scale Health related Costs: The impacts of UV Radiation are global. But given the small area of New Jersey, the UV intensity and its impacts should be more or less the same throughout the state. Thus the impacts are statewide.	3
	Uncertainty Extensive research has been made on the relationships between UV Radiation to skin cancer, cataracts and other health effects. The figures on the incidences of cases and their costs are well documented and are updated frequently, and thus are fairly reliable.	2
Aesthetic Values	Severity: UV Radiation is colorless and odorless, and does not produce any unpleasant visual elements or noise. It is unlikely to have any significant impact to the aesthetic values.	0.1
	Duration/irreversibility: Since the impact on aesthetic values is minimal, there is nothing to mention about duration or reversibility.	3
	Scale: Almost nothing about UV radiation on aesthetic values has happened, and no basis for judging in terms of frequency and scale.	3
	Uncertainty: There is low uncertainty.	1
Psychological Impacts	Severity: Although there is a general awareness about the harmful effects of direct sunlight, there does not appear to be a mass panic based on fear of UV radiation. However, a reviewer offered the following opinion: "There is an increased awareness of the dangers of increased UV exposure, and that awareness is occasionally manifested as fear and anxiety. Some people do avoid sun exposure, and others are worried about the exposures of their children." The assessment of psychological impacts is fairly subjective. While this analyst considers "1" to be the appropriate rating in this category, an uncertainty score of "3" indicates the real possibility that the rating should be a "2."	1
	Duration/irreversibility:	3
	Scale:	3

	Uncertainty: Low uncertainty.	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	(M) The information about the cost related to UV Radiation, especially those about the health issues, is updated frequently and it is very likely that the cost will rise dramatically when the incidences of skin cancer increase. The change of data for the other impacts, like the property values, is unlikely to happen.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	(-)Thinning of atmospheric ozone contributes to an increase of solar UV penetration to the earth's surface. It is expected that ozone depletion, unchecked, will result in an increase in UV exposure and the likelihood of an increase in the negative effects associated with such an increase. Due to the time lag between the reduction in use of CFCs and their removal from the atmosphere, the trend is expected to continue worsening for another decade before it begins to turn around.	
Potential for catastrophic impacts (H,M,L) and brief description	(L) A catastrophic reduction in atmospheric ozone sufficient to allow penetration of significant amounts of UVB and UVC would result in the destruction of life on earth. Yet it is extremely unlikely that such an event may occur.	
Incidence of impacts (affected sub-groups, variability, equity issues)	People working long hours in outdoors or conducting frequent on-site visits (e.g. construction workers, environmental technicians, and farmers) are more likely being affected. Skin cancer is higher on men than on women.	
Extent to which threat is currently regulated	Ozone depleting chemicals are regulated and are being phased out. This will eventually stabilize the UV exposure threat.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	M	
Small business industry	M: HHTWG considers tanning salons to be a non-trivial contributor.	
Transportation	L	
Residential	L	
Agriculture	L	
Recreation	L	
Resource extraction	L	

Government	M
Natural sources/processes	H
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	H
Biota sinks	L
References	1. Robert Kozachek, UV Radiation, Ecological Technical Work Group, New Jersey Comparative Risk Project. 2. Robert Kozachek, UV Radiation, Human Health Technical Work Group, New Jersey Comparative Risk Project. 3. Climate Change, Socio-Economic Technical Work Group, New Jersey Comparative Risk Project. 4. Mark Hartwig, Ultraviolet and Your Health. (www.arn.org/currpage/uvhealth.htm) 5. United Nations Environment Programme, Environmental effects of ozone depletion. (www.gcrio.org/OnLnDoc/unep97summary.htm) 6. Prentice-Dunn, Jones, Floyd. Persuasive Appeals and the reduction of skin cancer risk: the roles of appearance concern, perceived benefits of a tan, and efficacy information. Journal of Applied Social Psychology. V. 27, 1997, p. 1041-7. 7. Dickie, Gerking. Formation of risk beliefs, joint production and willingness to pay to avoid skin cancer. Review of Economic & Statistics. Vol. 78 (3), 1996, P.451-63. 8. Mills, Trouton and Gibbons. Symposium Report: Second Symposium on ultraviolet radiation-related diseases. Part. I. Revised consensus statements on ultraviolet radiation-related diseases. Volume 18 No. 1, 1997. (www.hc-sc.gc.ca/hpb/lcdc/publicat/cdic/cdic181/cd181e_e.html) 9. Environmental Effects of Ozone Depletion 1998 Assessment. Executive Summary. (http://sedac.ciesin.org/ozone/docs/UNEP98/UNEP98p2.html) 10. Kenneth Green. Rethinking EPA's Proposed Ozone and Particulate Standards. Reason Public Policy Institute, Policy No. 224, June 1997. (www.rppi.org/environment/ps224.html) 11. National Institute of Arthritis and Musculoskeletal and Skin Disease. Scientific Workshop Summary: Patient Outcomes in Basal Cell and Squamous Cell Skin Cancer. (www.nih.gov/niams/reports/pobcscsc.htm) 12. American Academy of Dermatology. Skin Cancer Fact Sheet. (www.aad.org/SkinCancerNews/WhatIsSkinCancer/SCancerFacts.html) 13. American Academy of Dermatology. Annual Direct Cost of Treating Melanoma Projected. (www.aad.org/PressReleases/annualdirect.html) 14. Cancer Epidemiology Service's Public Data Website. Melanoma Cancer Incidence. New Jersey: 1979-1996. (www.state.nj.us/health/cancer/publicdata/melanomas.htm) 15. UV Radiation. (www.epa.gov/ozone/uvindex/uvradiation.html) 16. National Alliance for Eye and Vision Research. Testimony. (www.eyeresearch.org/housetest00.html) 17. Office of the Governor. News Release (www.state.nj.us/governor/news/p00526b.html) 18. Ultraviolet Radiation. (www.state.nj.us/dep/rpp/ber/nrs/ultravio.htm)

	19. Bureau of Economic Analysis. CA05. Personal Income by Major Source and Earnings by industry. New Jersey. (www.bea.doc.gov/bea/regional/reis/ca05/34/) 20. Environmental Protection Agency. "What Has the EPA Done About Ozone Depletion?" 2000. www.epa.gov/ozone/geninfo/actions.html
Current Policy and Regulatory Framework	
Federal	The following is taken from the EPA home page[20]: In 1978, the use of CFC propellants in spray cans was banned in the U.S. In the 1980s, the Antarctic "ozone hole" appeared and an international science assessment more strongly linked the release of CFCs and ozone depletion. It became evident that a stronger worldwide response was needed. In 1987, the Montreal Protocol was signed and the signatory nations committed themselves to a reduction in the use of CFCs and other ozone-depleting substances. Since that time, the treaty has been amended to ban CFC production after 1995 in the developed countries, and later in developing. Today, over 160 countries have signed the treaty. Beginning January 1,1996, only recycled and stockpiled CFCs will be available for use in developed countries like the US. This production phaseout is possible because of efforts to ensure that there will be substitute chemicals and technologies for all CFC uses. As part of the United States' commitment to implementing the Montreal Protocol, the U.S. Congress amended America's Clean Air Act, adding provisions (under Title VI) for protection of the ozone layer. Most importantly, the amended Act required the gradual end to the production of chemicals that deplete the ozone layer. The U.S. federal agency primarily responsible for the management of air quality and atmospheric protection issues is the U.S. Environmental Protection Agency. The Clean Air Act amendments passed by Congress require that EPA develop and implement regulations for the responsible management of ozone-depleting substances in the United States. Under the Clean Air Act, EPA has created several regulatory programs to address numerous issues, including: ending the production of ozone-depleting substances ensuring that refrigerants and halon fire extinguishing agents are recycled properly; identifying safe and effective alternatives to ozone-depleting substances; banning the release of ozone-depleting refrigerants during the service, maintenance, and disposal of air conditioners and other refrigeration equipment; and requiring that manufacturers label products either containing or made with the most harmful ODS.
State & Local	Only the mercury vapor lamps, with UV content are being regulated in NJ.

Issue: Ultraviolet Radiation
Author: Kenneth Fung
Version: 12/14/00

Ultraviolet Radiation (UV). UV is a form of electromagnetic energy produced by the sun and by artificial sources. Chlorofluorocarbons and related chemicals are depleting the stratospheric ozone layer that shields the Earth from excess UV radiation. The intensity of UV Radiation can be determined by UV index, which is the amount of UV Radiation expected to reach the earth's surface at the time when the sun is highest in the sky. Excessive exposure of UV Radiation results in skin cancer (basal, squamous and melanoma), cataracts, sunburn, premature and aging of skin and immune system deficiencies.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Cost Incurred**	**Aesthetic Impacts**	**Psychological Impacts**
Severity	0.1	0.1	2	0.1	1
Duration/ Irreversibility	3	3	3	3	3
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.9	0.9	18	0.9	9

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
5.94	**5.94**

Socioeconomic Impact	**Property Values**	**Employment**	**Cost Incurred**	**Aesthetic Impacts**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	2	1	1	1.2

Trend: -

Catastrophic Potential: L

Issue: Volatile Organic Compounds
Author: John Posey
Version: 03/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Volatile Organic Compounds (VOCs)**
Description of stressor	VOCs are a group of carbon compounds with low solubility and a low boiling point. They include gasoline, alcohols, and many hydrocarbons. VOCs are found in many household products, including cleaners, solvents, varnishes and paints. In liquid form, VOCs tend to be highly aromatic because they evaporate rapidly. Of the 188 chemicals classified as Hazardous Air Pollutants (HAPs), about 50 are VOCs. It should be noted that there are several separate writeups on individual VOCs, including Benzene, 1,3-Butadiene, and PAHs. Thus, this writeup addresses only those "residual" VOCs that are not addressed in other writeups.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	VOCs affect human health in at least four ways. First, VOCs are considered to be precursors to ozone. When VOCs and nitrogen oxides are combined in the presence of sunlight, ozone and smog occur. Ground level ozone causes respiratory damage. Since this impact is discussed under the ozone writeup, it will not be considered further in this writeup. Second, VOCs have been known to seep into drinking water. The two most important VOC contaminants in drinking water are MTBE and chloroform, the latter of which is a disinfectant byproduct. Since these stressors are addressed in separate writeups, they will not be further considered here. Third, many VOCs are considered hazardous air pollutants. Some of these pollutants are the subject of separate writeups. These include benzene, 1,3-Butadiene, and some PAHs. Thus, these chemicals will not be discussed further in this writeup. However, other VOCs, such as ethylene oxide, carbon tetrachloride, methylene chloride and vinyl chloride are significant pollutants which are not addressed in other writeups. Thus, their effects will be considered in this writeup. Finally, VOCs have a negative impact on indoor air quality (IAQ). One IAQ stressor is formaldehyde, which is discussed in a separate writeup. In addition, a wide variety of VOCs are released from a host of household cleaners and cosmetics.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Cost of illnesses caused by VOCs not addressed in other writeups. Cost of illnesses caused by VOCs as indoor air pollutants. Quantitative information on this problem is more difficult to obtain.
Key impacts selected (critical socio-economic effects)	Costs Incurred
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Inhalation is the principal method of VOC exposure considered here. Over 90% of outdoor air pollution comes from either transportation or industrial processes, with smokestack emissions constituting slightly more than tailpipe emissions. Indoor pollution comes from a variety of household products.
Quantification of exposure levels statewide	Indoor VOC levels are difficult to obtain, as are measurements of tailpipe emissions. VOC point source emissions in NJ are as follows in tons per year (Source: EPA AIRSData, 2001): County Emissions

	Atlantic 340 Bergen 3,254 Burlington 2,627 Camden 1,891 Cape May 66 Essex 7,978 Cumberland 80 Gloucester 11,645 Hunterdon 1,946 Mercer 2,152 Middlesex 17,074 Monmouth 936 Morris 2,281 Ocean 158 Passaic 2,305 Salem 9,531 Somerset 784 Sussex 314 Union 18,363 Warren 998 Total: 94,393	
Specific socio-economic entities at increased risk	It appears that Middlesex, Union and Gloucester Counties face the highest exposure to outdoor VOCs. Persons living in newly constructed homes are at greater risk than persons in older homes.	
Quantification of exposure levels to entities at increased risk	Middlesex, Union and Gloucester Counties account for about half of all VOC point source emissions in NJ. Excess risk associated with new homes is not possible to quantify.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Concentration-response studies used to estimate cancer incidences due to VOCs.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: No impacts hypothesized	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Employment	Severity: No impacts hypothesized	*0.1*
	Duration/irreversibility	1

	Scale	3
	Uncertainty	1
Costs Incurred	Severity: *Outdoor VOC Exposure:* The table below shows the risks associated with several VOCs. The first column is the 10^{-6} risk, or the ambient level that would be expected to result in one lifetime case of cancer per million people. This is taken from the health benchmarks used in the Cumulative Risk Project, and is relied upon by the Human Health Technical Work Group (HHTWG). The second column shows the modeled ambient concentrations in 1996 from the EPA National Air Toxics Assessment (NATA). The final column is simply the quotient of the second column divided by the first column, and shows the number of cases of cancer per million people that would be expected given the ambient concentrations in column 2.	1

	10-6 risk	njavg	risk
Acetaldehyde	4.50E-01	1.21E+00	3.71E-01
Acrylonitrile	1.50E-02	7.04E-04	2.13E+01
Ethylene Oxide	1.00E-02	1.21E-02	8.29E-01
Hydrazine	2.00E-04	1.47E-04	1.36E+00
Methylene Chloride	2.10E+00	6.69E-01	3.14E+00
Trichloroethylene	5.90E-01	1.90E-01	3.11E+00
Vinyl Chloride	1.20E-02	2.58E-03	4.66E+00
Carbon Tetrachloride	6.70E-02	8.81E-01	7.60E-02
Ethylene Dibromide	4.50E-03	7.70E-03	5.84E-01

Source: USEPA Cumulative Exposure Project, 2001.

The final column adds up to 34.8. This may be multiplied by 8, since there are about 8 million people in NJ, resulting in a predicted 287 lifetime cases. This number may be divided by 70 to obtain the number of annual cases. This arithmetic results in an estimated 4 cases of cancer per year caused by the above VOCs. (It should be noted that HHTWG did not address the last five VOCs in the above table. However, the impact rating here would not change if these chemicals were omitted from this analysis. It should also be noted that the nine chemicals discussed here are a subset of the VOCs discussed under "Quantification of Exposure Levels Statewide," above.)

NIH data indicates that a typical case of cancer causes economic costs of about $60,000. This includes direct medical costs, lost work days and lost productivity. This estimate does not include mortality costs, or the cost of lost lifetime productivity caused by cancer deaths. See Brown, 2001 and the writeup on 1,3-Butadiene for a full description of the $60,000 estimate.

If the above estimates are correct, then we would expect medical costs associated with VOC-related cancers to be about $250,000 per year.

Indoor VOC Exposure: There is almost no epidemiological information on the number of illnesses caused by indoor exposure to VOCs. However, the EPA Indoor Environments Division (2001) reports that indoor levels are typically 2 to 5 times higher than outdoor levels. If we assume, then, that indoor VOC exposure causes about 2 to 5 times as many diseases as outdoor exposure, then the total cost of cancer caused by indoor exposure may be estimated at $500,000 to $1.25 million.

	There is also some evidence that indoor exposure to VOCs may be related to asthma and other respiratory conditions. However, work on this issue remains somewhat speculative, and Becher et al. (1995) conclude that the linkage "is far from elucidated." The total estimated cost, then, probably ranges between $1 million and $2 million. This is considered a low impact under NJCRP guidelines. It is possible that the total cost is much higher. The effect of indoor pollutants is potentially much greater. There is some evidence that certain VOCs found in hydrocarbons and perfumes may be associated with neurological damage. In addition, it is possible that VOC exposure causes minor respiratory discomfort. The total cost of these conditions may be much greater than the estimate provided here. Moreover, concentration-response information is only available on a handful of the dozens of VOCs considered to be hazardous. It may be that the cumulative effect of these chemicals exceeds the risk associated with the most prominent VOCs. Unfortunately, the evidence is still too limited to assert this with certainty. I conclude that available evidence indicates that costs associated with VOC exposure are fairly low, but there is much uncertainty regarding this assessment. It is worth noting that a recent report estimated that VOCs in drinking water may create health costs totaling $330 million nationwide (Lybarger, 1998). The report dealt with three chemicals: benzene, TCA, and TCE. The report based its findings on elevated incidence rates for strokes and birth defects occurring near Superfund sites known to contain these chemicals. However, the report did not control for smoking or for socio-economic status, and the authors conceded that causality remains uncertain. Although I do not find this report convincing, it would, if correct, significantly increase estimates of the costs of illnesses due to VOCs.	
	Duration/irreversibility	1
	Scale	3
	Uncertainty	3
Aesthetic Levels	Severity: Many VOCs produce an odor that most people would find offensive. Odors from solvents or cleaning materials fall into this category. However, it is difficult to assess whether this constitutes even a moderate impact from a societal level. I will therefore assign a low impact rating under severity, while noting that there is at least moderate uncertainty.	*1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	2
Psychological Impacts	Severity: No impacts hypothesized	*0.1*
	Duration/irreversibility:	1
	Scale:	3
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk	H: Quantitative information on exposure to indoor VOCs is sketchy. These pollutants may be much more significant than indicated by currently available evidence.	

estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ Nationally, outdoor VOC emissions declined from about 22.5 million tons per year to about 17.9 million tons per year in the 1990s. (EPA, 1998).
Potential for catastrophic impacts (H,M,L) and brief description	L
Incidence of impacts (affected sub-groups, variability, equity issues)	Indoor VOCs are fairly ubiquitous, and residents of new homes may be at greater risk. Compared to many other air pollutants, this is probably a fairly minor equity concern.
Extent to which threat is currently regulated	See Policy Framework, below.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	H: Industrial solvents are a major contributor to VOCs in the environment.
Small business industry	M: Dry cleaners contribute some VOCs to the atmosphere
Transportation	H: Transportation accounts for almost half of all VOC emissions.
Residential	M-H? Many household products contribute to indoor VOC air pollution.
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L

Orphan contaminated sites	L – Some drinking water contaminants may come from brownfields. As noted above, however, drinking water VOCs are discussed in other writeups, and are not the subject of this report.
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	L-M: Most VOC emissions remain localized.
Biota sinks	L
References	R. Becher, J. Hongslo, M. Jantunen and E. Dybing. "Environmental Chemicals Relevant for Respiratory Hypersensitivity: The Indoor Environment." *Toxicology Letters* 86(2-3), 1996. C. Chan, H. Ozkaeyank, J. Spengler, L. Sheldon and W. Nelson. "Commuter's Exposure to Volatile Organic Compounds." *Proceedings of the Annual Meeting of the Air and Waste Management Association*, 1989. Y. Cohen. "Volatile Organic Compounds in the Environment: A Multimedia Perspective." In W. Wang, J. Schnoor and J. Doi, eds., *Volatile Organic Compounds in the Environment*. West Conshohocken, PA: American Society for Testing and Materials. A. Hodgson, A. Rudd, D. Beal and S. Chandra. "Volatile Organic Compound Concentrations and Emission Rates in New Manufactured and Site-Built Houses." *Indoor Air: International Journal of Indoor Air Quality and Climate* 10(3), September 2000. J. Lybarger et al. "Medical Costs and Lost Productivity from Health Conditions at Volatile Organic Compound Contaminated Superfund Sites." *Environmental Research* 79(1), October 1998. G. Pezzoli et al. "Hydrocarbon Exposure and Parkinson's Disease." Neurology 55(5), September 2000. U.S.EPA Office of Air Quality Planning and Standards. National Air Quality and Emissions Trends Report, 1998. U.S.EPA AIRSData. "New Jersey NET Air Pollution Point Sources: Volatile Organic Compounds. March 7, 2001. U.S.EPA Cumulative Exposure Project. Toxicity Database. http://www.epa.gov/cumulativeexposure/resource/toxdata.htm. 2001. U.S. EPA Indoor Environments Division. Organic Gases (Volatile Organic Compounds—VOCs). February, 2001. U.S. Geological Survey. "Occurrence and Concentrations of Volatile Organic Compounds in Shallow Ground Water in the Lower Susquehanna River Basin, Pennsylvania and Maryland." 1996. J. Vasconcelos, L. Leong and J. Smith. "VOC Emissions and Associated Health Risks." Water Environment and Technology 3(5), 1991. G. Wieslander, D. Norbaeck, E. Bjoernsson, C. Janson and G. Boman. "Asthma and the Indoor Environment: The Significance of Emission

	of Formaldehyde and Volatile Organic Compounds from Newly Painted Indoor Surfaces." *International Archives of Occupational and Environmental Health* 69(2), 1997. G. Wieslander, D. Norbaeck and C. Edline. "Airway Symptoms Among House Painters in Relation to Exposure to Volatile Organic Compounds: A Longitudinal Study." Annals of Occupational Hygiene 41(2), 1997.
Current Policy and Regulatory Framework	
Federal	The regulatory framework for VOCs is very complex. EPA regulation concerning indoor exposure to VOCs is set forth in the Code of Federal Regulations Title 40 Chapter I Subchapter C Part 59. Subpart B regulates VOC content in seven categories of automobile refinishing coatings. Subpart C sets VOC maximum weight percent content limits for 40 categories of household products, including shaving cream, laundry products, household adhesives, hair care products, dusting aids and air fresheners. Subpart D regulates VOC content in architectural coatings, including sealants, lacquers, shellacs, stains, and wood preservatives. Outdoor exposure is regulated in several different Parts of the same Chapter. Part 63 regulates Hazardous Air Pollutants, of which about 50 are considered VOCs. Part 61 regulates industrial emissions of vinyl chloride and ethylene dichloride. Part 85 regulates emissions from mobile sources. In addition, 40CFR Chapter I Part 165 contains regulations from the Food and Drug Administration regarding maximum limits about 20 different VOCs in bottled water. The EPA also regulates about 20 different VOCs in drinking water. Additional regulations pertaining to Ozone formation are discussed in a separate

	writeup.
State & Local	VOCs are regulated under the Air Pollution Control Act of 2000. Chapter 2C instructs the DEP to develop rules and regulations not inconsistent with U.S. law for the control of VOCs. (Hospital disinfectants are specifically excluded from VOC regulations.) NJ has asked the EPA for permission to allow polluters to trade VOC pollution credits in a market, similar to the SO2 trading market. The EPA is expected to approve the NJ proposal. This rule change would apply primarily to regulations pertaining to ozone formation.

Issue: Volatile Organic Compounds
Author: John Posey
Version: 03/01

Volatile Organic Compounds (Residual): VOCs are a group of carbon compounds that include gasoline, alcohols and many hydrocarbons. VOCs comprise about 50 of the 188 chemicals classified as hazardous air pollutants by the EPA. (This report does not address VOCs discussed in other writeups, such as benzene, formaldehyde, 1,3-butadiene, chloroform , PAHs and MTBE. The contribution of VOCs to ground-level ozone is also omitted from this report.) Outdoor VOC pollution results from tailpipes and smokestacks. Indoor VOC pollution can come from a variety of products, including cleaners, paints, varnishes, nail polish, and building materials. Outdoor VOC pollution declined in the 1990s. In NJ, outdoor VOC pollution probably causes less than 10 cases of cancer each year. Indoor VOC pollution is potentially much more serious, although there is little hard data on this problem. Additional research on indoor VOCs would be helpful.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	1	1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	3	3	0.3

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
1.38	**1.38**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	3	2	1	1.6

Trend: +

Catastrophic Potential: L

Issue: Water Overuse
Author: John Posey
Version: 03/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework | Findings/Notes

Hazard Identification	
Stressor	**Water Overuse**
Description of stressor	The overuse of water leads to depletion of aquifers. This can lead to saltwater intrusion, which results in the contamination of groundwater. Depletion of surface water is also a possibility. Remedying this problem can require expensive capital improvement projects that allow water to be piped in from other areas. To the extent that capital improvements are used to overcome water shortages, the cost of aquifer depletion will be reflected in water rates paid by consumers. The New Jersey State Water Use Plan calls for some new construction, in anticipation of population increases, as well as strong conservation measures to ensure the sustainable use of water resources.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Depletion of groundwater and surface water threatens losses of biodiversity and biological integrity. Depletion of aquifers near the ocean can lead to saltwater incursion, the state in which seawater leaches into aquifers, thus contaminating drinking water supplies.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Depletion of water increases costs associated with water distribution.
Key impacts selected (critical socio-economic effects)	Costs Incurred.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Depletion of water can result both from increasingly inefficient use of water and from increasing development pressures.
Quantification of exposure levels statewide	According to the 1996 New Jersey State Water Supply Plan (NJSWSP), current water supplies allow a sustainable water draw of up to 1,750 million gallons per day (MGD). Currently, the state uses about 1500 MGD. However, if current population trends continue, the state will exceed current supplies by the year 2040. The term "water supply deficit" denotes the practice of using more water from an aquifer (or surface water) than can be replenished through precipitation.
Specific socio-economic entities at increased risk	According to NJSWSP, 8 of the 21 planning areas in the state that are at heightened risk. These are the Camden-Delaware Tributaries, the Mullica River, the South River, Metedeconk Creek/Tom's River, the Maurice River, the Hackensack River, the Cape May coastal area, and the lower Passaic/Rahway rivers. Most of these counties are in the southern half of the state. (See below).
Quantification of exposure levels to entities at	The Camden/Delaware tributaries area is experiencing a small current supply deficit, although existing regulations on aquifer draws are expected to solve this problem.

increased risk	The Mullica River region is currently experiencing a water supply deficit of 56 MGD. By 2020 this is projected to increase to 84 MGD. NJSWSP cautions that there is a high degree of uncertainty regarding this estimate, and does not recommend major capital improvements at this time. The South River area currently has a water supply deficit of 27 MGD. This watershed provides about 37% of the water used in Middlesex County, and about 12% of the water used in Monmouth County. The current deficit for the Metedeconk/Tom's River area is 20 MGD. This is projected to increase to 34 MGD by 2020. This watershed provides about 28% of the water used in Ocean County. The Maurice River area has an 8 MGD deficit. This is projected to double in the next 20 years. This area provides 87% of the water used in Cumberland County, as well as about a quarter of the water in Salem and Gloucester Counties. The Hackensack River area has only a small deficit, which is being remedied without major capital expense. The Cape May coastal area currently has a water supply surplus, but current trends indicate that a deficit is likely by the year 2020. The lower Passaic/Rahway area currently had a deficit of 9 MGD in 1996. The drafters of the plan believed that this watershed was losing population, and that the problem could thus be fixed without major capital expense. However, the 2000 census showed that municipalities located within the Lower Passaic watershed had gained more than 30,000 people in the 1990s. Thus, this watershed may pose more of a problem than was anticipated in 1996. The plan provided no estimate of the costs of correcting the water deficits in this watershed. Regrettably, the resident population of watershed areas was not available at the time of this writeup.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	DEP used computer hydrological modeling to simulate water supply and demand. The demand estimate was constructed by estimating future population increases, holding demand per person constant. This does not incorporate possible behavioral responses to price increases.
Risk Characterization	

Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: Depletion of aquifers could lead to higher water rates in some areas. In theory, higher infrastructure costs could lead to higher water rates, and these higher water rates could be reflected in reduced property values. However, there is little evidence available with which to measure this effect, and little indication that it will become acute in NJ in the next five years.	*1*
	Duration/irreversibility	2
	Scale	1
	Uncertainty	3
Employment	Severity: Water scarcity could potentially lead to employment losses in sectors such as agriculture, which depend heavily on water. It would be a localized rather than a statewide effect, and hence it would probably have a low impact. However, there is little evidence available to measure this effect.	*1*

	Duration/irreversibility	1
	Scale	1
	Uncertainty	3
Costs Incurred	Severity: NJSWSP provides estimates of the costs required to remedy water supply deficits. Based on the success of 1982 plan for which NJSWSP is the successor, it is likely that the recommended projects will actually be implemented in the next decade. The major costs estimated by NJSWSP were: Raritan/South River: $128 million. Camden/Delaware: $170 million Cape May: approximately $10 million. Thus, the cost of remediating the water supply deficits in these areas are expected to total over $300 million. NJCRP guidelines call for an assessment of the unremediated costs associated with environmental stressors. Thus, it is not obvious that costs of remediation should fall into an NJCRP cost assessment. However, at some level, a society's willingness to pay for environmental remediation must at least be equal to the utility that society would lose from failure to remediate. Put another way, economic theory predicts that economic actors will continue to increase spending on environmental remediation until the marginal cost of remediation is equal to the marginal cost of leaving a problem unremediated. If this is the case, then it is appropriate to use remediation costs as a proxy for the unremediated costs associated with a stressor. From more of a common sense approach, it is clear that water overuse will result in higher water bills, and that these costs would not be incurred in the absence of water overuse. Thus, it seems reasonable in this case to include remediation costs in an impact assessment. It should be noted that if left unremediated, the depletion of aquifers could lead to saltwater intrusion, the state in which sea water leaches into ground water, thus contaminating this drinking water supply. Large-scale saltwater intrusion could create both ecological and human health impacts. It is difficult to predict the economic impact of these changes, however. According to USGS, since 1940 more than 120 wells in Cape May County have had to be abandoned because of saltwater intrusion. It is not likely that this will result in significant costs over the next five years. However, it is a long-term potential effect that deserves attention. Assuming that the capital improvements will be contracted over the next 10 years, the costs incurred are sufficient to warrant a rating of "moderate" under NJCRP guidelines. In addition to capital improvements, NJSWSP places a great deal of emphasis on water conservation, and on the concept of sustainable use. See "State Regulation," below.	*2*
	Duration/irreversibility: With sufficient resources (or reform in water rates), it seems possible to fix the problem.	2
	Scale: Moderate—the problem is most concentrated in the southern part of the state.	2
	Uncertainty: There is fairly high uncertainty here. Water conservation measures hold the potential to dramatically reduce costs.	3
Aesthetic Levels	Severity: No impacts hypothesized	*0.1*
	Duration/irreversibility	2
	Scale	2

	Uncertainty	1
Psychological Impacts	Severity: This is a concern in some areas of the state.	*1*
	Duration/irreversibility:	2
	Scale:	2
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: Additional information on the effect of water supply on property values and employment would allow a more detailed assessment. In addition, more information about the price elasticity of demand for water in NJ could contribute to an understanding of costs and benefits of both construction and conservation measures. Espey et al. (1997) and Hewitt and Hanemann (1995) provide evidence that demand for water is not inelastic. Research on the application of demand elasticity measures to conservation-promoting water rates in NJ would be a fertile field for further study. NJSWSP calls for additional analysis of the projected Mullica River watershed deficit. Additional analysis is needed to determine the locations of withdrawals, and to determine whether these withdrawals are consumptive or depletive. The potential for saltwater incursion in this region should also be studied. It would also be helpful to know the extent to which water use is occurring because of consumption through public water systems, as opposed to private wells. For overuse that occurs via public water systems, economic incentives for conservation can be employed to solve the problem. For overuse due to over-pumping of individual wells, options are limited without an institutional framework for resolving the "tragedy of the commons."	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	- In the absence of an aggressive water conservation policy, population increases may be expected to lead to increased demands on the state's water resources. It should be noted that increased attention to the concept of sustainable use also has the potential to solve the problem of water overuse, and that NJSWSP emphasizes this idea. Policies designed to encourage conservation could reduce long-term demand for water. Possible conservation measures may include reduced-volume toilet flushes and water-saving devices on showerheads. Proper maintenance to reduce leaking also offers potentially large savings. Such conservation measured could be much cheaper than new construction. As an EPA reviewer noted, "each time California has gained access to additional water resources, demand has risen and caused subsequent shortages. This is why the true remedy is conservation and sustainable use." (See section on regulation, below.)	
Potential for catastrophic impacts (H,M,L) and brief description	L: There is no reason to believe that water shortages will become acute in NJ in the next five years because technical fixes are available, albeit at a significant cost. It should be noted that potential future global climate change could have a dramatic impact on the nation's water supply and demand. This, however, is beyond the scope of this writeup.	
Incidence of impacts (affected sub-groups, variability, equity issues)	This problem does not seem concentrated on any particular demographic group. Since water is a regulated utility, it should be possible to design rate structures that offset impacts on disadvantaged groups. Geographically, the southern part of the state, which relies heavily on groundwater, is projected to face the greatest water supply deficits by 2020 in the absence of remediation. The greatest water supply deficit in 2020 is projected to occur in the Mullica River watershed. This watershed provides 25-50% of the water used in the counties of Atlantic, Burlington, and Camden. Other counties expected to face deficits include Cumberland, Ocean and Camden.	
Extent to which threat is currently regulated	Water supply in NJ is regulated under several statutes: The Water Supply Management Act of 1981 mandated a state planning effort. The Water Supply Bond Act of 1981 created a $350 million bond fund for capital improvements related to water supply. The Safe Drinking Water Act of 1977 mandated compliance with federal clean water regulations. The 1982 plan outlined the construction projects for which the bond fund would be used. The Water Supply Authority Act established the NJ Water Supply Authority.	

	Other relevant statues included the Water Pollution Control Act and the Small Water Company Takeover Act. As noted above, the 1996 NJSWSP was formed to guide water management in NJ over the next 20 years. In addition to the recommended capital improvements described above, NJSWSP also calls for additional attention to water conservation and sustainable use. To this end, watershed protection programs in DEP work to minimize pollution of groundwater sources. Through an Aquifer Recharge Program, DEP works with local and county governments to design zoning codes that preclude future overuses of water supplies. Other aspects of the Aquifer Recharge Program include a septic management that encourages the recycling of treated wastewater and a wellhead protection program. In addition, DEP has called for legislation that allows the state to buy land in wellhead protection areas. In the area of conservation, NJSWSP distinguishes between structural vs. behavioral measures. Behavioral measures require the compliance of consumers (e.g., taking shorter showers or abstaining from watering of lawns). Structural measures work through infrastructure design to minimize waste. Examples of structural measures include the revision of plumbing codes to provide for 1.6 gallons per flush toilets and 2.5 gallons per minute showerheads. While both types of measures are helpful, NJSWSP generally favors structural solutions. NJSWSP calls for educational programs to encourage behavioral change, as well as other structural measures such as incentives to reduce leakage in private water supply companies. A policy that straddles the structural/behavioral distinction is the use of rate structures to encourage conservation.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	M
Small business industry	M
Transportation	L
Residential	H
Agriculture	H
Recreation	L
Resource extraction	H
Government	L
Natural sources/processes	M: Aquifer depletion can lead to heightened salt water intrusion on aquifers located near the coast.
Orphan contaminated sites	L
Diffuse Sources	

Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	Molly Espey, J.A. Espey, and W. D. Shaw (1997). "Price Elasticity of Residential Demand for Water: A Meta-Analysis", Water Resources Research, 33(6): 1369-1374. Hewitt, Julie A. and W. Michael Hanemann. 1995. A Discrete/Continuous Choice Approach to Residential Water Demand Under Block Rate Pricing, *Land Economics* 71(2): 173-192. Wade, William W., J.A. Hewitt and M.T. Nussbaum. 1991. Cost of Industrial Water Shortages. Report prepared for California Urban Water Agencies, Sacramento, CA. New Jersey Department of Environmental Protection. Water for the 21st Century: The Vital Resource—New Jersey Statewide Water Supply Plan. 1996 New Jersey Water Withdrawals 1990-96. U.S. Census Bureau: New Jersey Municipalities, 1990-2000. 2001. United States Geological Survey. Public Supply Water Use in the United States. http://ga.water.usgs.gov/edu/tables/dlps.html Lawrence Hajna and Kim Mulford. "Water Limits in Glouco May Bring Rate Hikes." *Courier-Post*, January 7, 2001.

Issue: Water Overuse
Author: John Posey
Version: 03/01

Water Overuse: The overuse of water can lead to the depletion of aquifers. The term "water supply deficit" denotes the practice of using more water from ground or surface water than can be replenished through precipitation. Currently there is no statewide water supply deficit, although a deficit will develop by the year 2040 if current population growth continues. Eight of the 21 water planning regions in the state are experiencing current water supply deficits. These are mostly concentrated in southern NJ, where dependence on ground water is greater. Remediating current water supply deficits will probably cost more than $300 million.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	2	0.1	1
Duration/ Irreversibility	2	1	2	2	2
Scale (spatial, population)	1	1	2	2	2
Subtotal Risk	2	1	8	0.4	4

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
3.08	**3.08**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	3	3	3	1	1	1.2

Trend: -

Catastrophic Potential: L

Issue: Waterborne Pathogens
Author: John Posey
Version: 03/28/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Waterborne Pathogens**
Description of stressor	Any disease that is transmitted through water may be considered a waterborne pathogen. Examples include diseases such as cholera, typhoid fever and dysentery. Cryptosporidium, a major pathogen in the U.S., is considered in a separate writeup. Waterborne pathogens may be categorized as bacterial (e.g., salmonella and shigella), protozoan (giardia, cryptosporidium) and viral (norwalk virus, polio).
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Waterborne pathogens cause disease in humans. The most common type of affliction is gastrointestinal ailments, especially diarrhea. In most cases, illnesses caused by waterborne pathogens result only in mild diarrhea and gastrointestinal discomfort. However, these illnesses can lead to hospitalization, and in rare cases, death.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Costs associated with waterborne disease include medical costs and lost productivity.
Key impacts selected (critical socio-economic effects)	Costs Incurred.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Ingestion is the most common form of transmission. This can occur from both drinking water and from recreational water activities.
Quantification of exposure levels statewide	Estimates of the number of cases vary wildly. HHTWG reports that the CDC, in 1987, estimated that there were 940,000 cases of illness annually that were attributable to waterborne pathogens. Levin and Morris (as reported in Ford, 1999) estimated incidence of reported and unreported cases based on a review of published estimates of various diseases. There were a total of 7.3 million estimated cases. The pathogens for which estimates were provided were as follows: Bacteria: Salmonella 59,000 Shigella 35,000 E. Coli 150,000 Campylobacter 320,000

	Legionella 13,000 Giardia (protozoa) 260,000 Viruses 6,500,000 Payment used a different method to reach a much larger estimate. He used observations of randomly selected families over an 18 month period to estimate that Americans contract, on average, 0.7 cases of gastrointestinal illness per person per year. Of these, he estimates that 10% to 30% may be attributed to waterborne pathogens. If this is the case, then there may be 20 million to 60 million cases each year in the U.S. Ford's data indicates that there may be about 200,000 cases of waterborne disease in NJ each year, assuming that NJ's share of illnesses is proportional to its share of the U.S. population. If Payment's estimate is used, then there may be between 600,000 and 1.8 million cases each year. It must be stressed that most cases are fairly mild, and do not result in a patient seeking medical attention. These estimates include mild cases of diarrhea that do not result in lost work days or productivity, let alone medical expenses.	
Specific socio-economic entities at increased risk	Waterborne pathogens can strike virtually anyone, anywhere.	
Quantification of exposure levels to entities at increased risk	N/A	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Three types of quantitative methods have been employed to estimate the annual impact of waterborne pathogens. Payment relied on a long-term study of randomly studied families. The CDC relies on voluntarily reported data. Morris and Levin (as reported by Ford) conducted a meta-analysis of published estimates of rates of incidence.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: No impacts hypothesized.	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Employment	Severity: No impacts hypothesized	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1

Costs Incurred	Severity: Payment provides cost of illness estimates for gastrointestinal ailments caused by waterborne pathogens. He estimates that a typical case creates about $300 in direct medical costs (estimate converted to 2001 dollars). Moreover, about 15% of all cases result in lost work days. These cases, on average, result in lost wages and productivity in the amount of about $300. If the CDC totals cited by HHTWG are used, then the total cost is: 28,000 * 300 + 28,000 * 0.15 * 300 = $9.7 million. If Ford's estimates of disease incidence are used, then the total cost is: 200,000 * 300 + 200,000 * 0.15 * 300 = $69 million If the incidence rate estimated by Payment is used, then the latter cost estimate would be multiplied by a factor of at least 3. I believe that it is prudent to use the middle figure, with the caveat that there is a serious possibility that this figure is either too low or too high. NJCRP guidelines call for a score of "2" to be given to impacts ranging from $16 million to $160 million.	*2*
	Duration/irreversibility: Most cases are short-lived and reversible.	1
	Scale: Statewide	3
	Uncertainty: Could be higher or lower.	3
Aesthetic Levels	Severity: No impacts hypothesized	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Psychological Impacts	Severity: No impacts hypothesized	*0.1*
	Duration/irreversibility:	1
	Scale:	3
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	H: incidence of waterborne viral ailments is not well understood. The best available estimates may over-report or under-report greatly.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	- The Encyclopedia of Water reports that cases of giardia infection doubled in each 5 year period from 1965 to 1985. In addition, some authors have raised concerns about new strains of emerging pathogens. The effects of these pathogens will probably not be known for several years.	
Potential for catastrophic impacts (H,M,L) and brief	L: There is a small possibility that waterborne pathogens could enter public water supplies and cause modest distress to a large number of people.	

description	
Incidence of impacts (affected sub-groups, variability, equity issues)	There is no discernible variation across geodemographic groups.
Extent to which threat is currently regulated	The following is taken from the EPA Office of Water home page: EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels: Cryptosporidium: (as of January 1, 2002) 99% removal/inactivation Giardia lamblia: 99.9% removal/inactivation Viruses: 99.99% removal/inactivation Legionella: No limit, but EPA believes that if Giardia and viruses are removed/inactivated, Legionella will also be controlled. Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month. HPC: No more than 500 bacterial colonies per milliliter. Under EPA guidelines, no more than 5.0% of all samples in a month can test positive for any type of coliform, at any level. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive). Every sample that has total coliforms must be analyzed for fecal coliforms. There may not be any fecal coliforms or E. coli. Fecal coliform and E. coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	L
Small business industry	L

Transportation	L
Residential	H Most waterborne pathogens strike through drinking water.
Agriculture	L
Recreation	M: Some waterborne diseases are spread through recreational water activities.
Resource extraction	L
Government	M: HH TWG points to municipal sewage treatment plants.
Natural sources/processes	H: Waterborne microorganisms are naturally occurring phenomena.
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	H: See natural sources, above.
References	US EPA, Office of Water. "Current Drinking Water Standards." 2001. www.epa.gov/safewater/mcl.html U.S. Center for Disease Control. "Surveillance for Waterborne Disease Outbreaks—United States, 1995-96." December 11, 1998. www.cdc.gov/epo/mmwr/preview/mmwrhtml/00055820.htm Tom Mahin and Oscar Pancorbo. "Waterborne Pathogens." *Water Environment and Technology* 11(4), April 1999. Vermont Department of Health. "Waterborne Pathogens." 1998. www.anr.state.vt.us/champ/pathogen.htm T.E. Ford. "Microbiological Safety of Drinking Water: United States and Global Perspectives." *Environmental Health Perspectives* 107(2)(suppl.), February 1999. P. Payment et al. "Epidemiological of Endemic Gastrointestinal and Respiratory Diseases: Incidence, Fraction Attributable to Tap Water and Costs to Society." *Water & Science Technology* 35(11-12), 1996. Frits van der Leeden. *The Water Encyclopedia*. Chelsea, Mich. : Lewis Publishers, 1990. "Committee Report: Emerging Pathogens—Viruses, Protozoa and Algal Toxins." *Journal of the American Water Works Association* 91(9), September 1999.

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Current Policy and Regulatory Framework	See "Regulation" above
Federal	
State & Local	

Issue: Waterborne Pathogens
Author: John Posey
Version: 03/28/00

Waterborne Pathogens: Many diseases including cholera, dysentery and typhoid fever are spread through water. In the U.S., the most serious waterborne pathogens are cryptosporidium, giardia, campylobacter, e. coli, and waterborne viruses. (Cryptosporidium is addressed in another writeup, so its effects are excluded from this writeup.) Usually, the symptoms caused by these pathogens are limited to mild diarrhea and gastrointestinal discomfort, although on rare occasions these illnesses can result in hospitalization and even death. The vast majority of cases go unreported and undiagnosed, so it is difficult to estimate the number of cases each year. However, scholars using different estimation techniques have agreed that waterborne pathogens probably cause several million cases of gastrointestinal illness in the U.S. each year. If the number of cases in NJ is proportional to its population, then we may expect that between 200,000 and a million cases of these illnesses occur in NJ each year. Available cost of illness estimates indicate that these cases cost the NJ economy more than $70 million each year in medical costs and lost productivity.

Socio-economic Impact Evaluation of Environmental Issue:

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	2	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	6	0.3	0.3

Average Risk (0 – 5 years)	**Average Risk**
1.44	**1.44**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	3	1	1	1.4

Trend: -

Catastrophic Potential: L

Issue: West Nile Virus
Author: John Posey
Version: 9/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor Specific Risk Assessment

West Nile Virus

The first occurrence of West Nile Virus in the United States was documented in 1999. West Nile Virus is an arbovirus. It is closely related to St. Louis encephalitis, but produces milder symptoms. WNV is transmitted from the bite of a mosquito that has drawn blood from an infected bird. The first human WNV fatality in NJ was reported on September 27, 2000. Previously there had been only 2 reported cases. As of September 27, tests are pending on 34 people in NJ who have shown symptoms similar to WNV. Seven deaths in New York were blamed on the virus last year. There have been 11 human cases in New York City this year, including eight in Staten Island, but no deaths.

According to the 9/27/00 Dow Jones News Wire, " New Jersey has set up an extensive monitoring and mosquito control operation to combat and track the disease. The head of the federal Centers for Disease Control, Dr. Jeffrey P. Koplan, visited Bergen County on Thursday to review the state's efforts, calling them "a textbook example" of how to deal with a public health threat."

On September 27, it was also reported that 2 dead crows in the Philadelphia area tested positive for WNV, the first appearance of the disease in Pennsylvania.

Several New York counties have begun spraying for WNV this year. On September 25, a group of Cornell biologists released a statement arguing that spraying was an ineffective strategy. According to the scientists, mosquitoes will likely develop resistance to the spray, and pesticides use carries additional risk to ecological quality and human health. The scientists noted that the pesticides used were, like many pesticides, potentially lethal to fish, birds and bees. The scientists also alleged that the pesticides pose potential threats to human health.

Issue: West Nile Virus
Author: John Posey
Version: 9/00

West Nile Virus: The first case of West Nile Virus in the U.S. was documented in 1999. The virus killed 7 persons in New York in 1999. The first NJ fatality was reported on September 27, 2000. The virus is spread by mosquitoes that draw blood from infected birds. 537 crows in NJ have tested positive for WNV. Although it is impossible to predict the course that the disease will take over the next five years, it is clear that the virus is still spreading throughout the northeastern U.S. Thus, the threat could grow in coming years. Continued research and monitoring efforts are warranted.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	0.1	1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	0.2	0.2	2	0.2	2

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.92	**0.92**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	1	1

Trend: --

Catastrophic Potential: L

Issue: Zebra Mussels
Author: John Posey
Version: September 2000

NJ Comparative Risk Project
Socio-economic TWG
Issue Writeup Template: Zebra Mussels

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Zebra Mussels**
Description of stressor	Zebra mussels are a thumbnail-sized freshwater mollusk. The species is native to the Caspian Sea region of western Asia, and was introduced to the Great Lakes approximately 20 years ago through a discharge of ballast water from a European cargo vessel. Since then, the zebra mussel has invaded 20 states. Zebra mussels can cause local extinction of native mollusks. In addition, zebra mussels can alter ecosystems by consuming aquatic microorganisms that are at the base of the food chain.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	EQTWG finds that the zebra mussel has a serious impact on biological integrity and biodiversity. The principal socioeconomic impact is the cost imposed on water works and utilities because of clogged intake pipes.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Employment, property values, costs incurred, aesthetics, psychological impacts.
Key impacts selected (critical socio-economic effects)	Costs incurred, aesthetics.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Since entering the US through a discharge of ballast water, zebra mussels have spread through the Great Lakes and into the Mississippi-Missouri river systems. Zebra mussels can cling to any solid surface, and are thought to have been further spread by the hauling of boats from infested waters to pristine waters. Zebra mussel larvae are microscopic, and can be carried unintentionally by recreational boaters or commercial fishers. Zebra mussels are working their way down the Hudson, and are currently thought to be north of the Tappan Zee. It is not known how long it will take for them to spread into NJ waters. To date there have been no sightings on the Delaware River, but the introduction of this species remains a threat to all freshwaters in NJ.
Quantification of exposure levels statewide	None to date. Future incursions are likely, but the extent is still unknown.
Specific socio-economic entities at increased risk	Water works and utilities with freshwater intake and outflow pipes.
Quantification of exposure levels to entities at increased risk	Same as statewide.

Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Review of literature studying economic costs, primarily through survey research.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	a) Severity: I have been unable to find any quantitative information concerning the effect that zebra mussels may have on property values.	0.1
	b) Duration/irreversibility	1
	c) Scale	2
	d) Uncertainty: Any effects will not be known until zebra mussels reach NJ waters.	2
Employment	a) Severity: It is possible to imagine adverse effects that zebra mussels may have on state employment. First, the zebra mussel can cause other freshwater mollusks to become locally extinct, threatening the jobs of those who harvest these shellfish for commercial purposes. Second, the zebra mussel could affect freshwater ecosystems, resulting in the death of freshwater vertebrates. This could also threaten the jobs of those who harvest these fish for commercial purposes. Third, these effects could damage the ecotourism industry. There is no evidence to indicate that any of these possible effects could actually threaten to occur in NJ. First, although saltwater mollusks play an important role in the NJ economy, freshwater mollusks are, from an economic standpoint, insignificant. Second, there is some evidence that zebra mussels actually increase populations of freshwater vertebrates such as perch. Thayer et al. report in the Canadian Journal of Fisheries and Aquatic Sciences that the fecal pellets excreted by zebra mussels enrich the bottom of lakes, providing habitats for the invertebrates that perch and other fish feed on. As a result, zebra mussels have led to an increase in yellow perch and other fish populations. Thus, it appears that jobs dependent on the harvest of freshwater vertebrates will not suffer as a result of zebra mussel invasion. Third, since freshwater fishing opportunities will not be diminished because of the zebra mussel, it is unlikely that ecotourism will be affected. Moreover, since zebra mussels enhance water clarity, they may encourage ecotourism. I conclude, therefore, that employment impacts will be negligible.	0.1
	b) Duration/irreversibility	1
	c) Scale	2
	d) Uncertainty: It will be impossible to fully assess employment impacts until zebra mussels actually enter NJ waters.	2

Costs Incurred	a) Severity: According to a widely cited report by Pimentel et al. (1999), "zebra mussels also invade and clog water intake pipes and water filtration and electric generating plants; it is estimated that they will cause $5 billion/yr. in damages to these facilities and associated control costs by the year 2000." In July 2000, USGS reported that zebra mussels have been spotted in 20 states, with a combined population of 120 million. If New Jersey sustains damage proportional to its population, then it will suffer losses of $336 million once it becomes infested with zebra mussels. However, this is unlikely to occur within the next five years, which is the time horizon for the NJCRP analysis.	1
	b) Duration/irreversibility: These problems will be highly reversible if NJ water companies and utilities adopt intake pipe designs currently used in Europe to filter out zebra mussels.	1
	c) Scale: Approximately half of the state of NJ receives its drinking water from surface waters.	2
	d) Uncertainty: The cost of zebra mussels on water works and electric plants in the Great Lakes is well documented. However, since it is not known whether and when zebra mussels will enter NJ waters, particularly the Delaware River, uncertainty must be considered fairly high.	3
Aesthetic Levels	a) Severity: A debate has emerged in the ecological community regarding the harmfulness of exotic species. Most mainstream ecologists agree that the introduction of non-native species, particularly those that threaten native species, is a harmful development. However, mavericks such as Mark Sagoff of the University of Maryland, argue that exotic species are not inherently any worse, or more harmful, than native species. Sagoff argues that non-native species can actually be beneficial to ecosystems. He claims that the zebra mussel has had some beneficial effects: "It devours the excess nutrients and associated algae that result from agricultural runoff and municipalities' waste discharge, and through that process it helps to clean lakes and rivers. Scientists from Ohio State University have reported that because of the mussel, at least 14 species of native aquatic plants have reappeared in Lake Erie after an absence of more than 30 years. The mussel has made the water clearer, so the plants once again have enough sunlight to flourish. Scientists credit the mussel, along with antipollution efforts, with returning Lake Erie to a condition similar to that of a century ago." The resolution of this debate ultimately hinges on value judgments. Ronald Bailey evaluates the argument as follows: "The preference for native over non-native species is essentially 'a religious one,' says Mr. Sagoff. That doesn't mean it isn't valid, but it does mean that ecologists and environmentalists can't simply justify their preference for native species on the basis of economic fiddling that lumps together basically benign alien species willy-nilly along with bad actors. Nor should ecologists attempt to justify their prejudices through recourse to 'objective' science. An argument against alien species 'must be explicitly an aesthetic one or historical one,' he says. 'Ecology should not attempt to become a normative science.' The evaluation of this debate should be left to the steering committee. Since the zebra mussel is not yet in NJ, the current threat is insignificant.	0.1
	b) Duration/irreversibility	1

	c) Scale	2
	d) Uncertainty	3
Psychological Impacts	a) Severity: Zebra mussels have received considerable attention from the popular press. This could have the effect of worrying the average NJ citizen, especially those who own property on lakes or rivers. It has probably already become a low-level worry for some residents.	1
	b) Duration/irreversibility: Unknown.	1
	c) Scale: Persons who live near lakes or streams are likely to be more worried than most.	2
	d) Uncertainty: I have little confidence in this assessment.	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	H: Estimates are speculative, since it is not known how soon zebra mussels will enter NJ waters.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	-- Ecologists in the EQTWG seem fairly confident that zebra mussels are on their way to New Jersey. However, it may still be possible to devise ways to keep zebra mussels out of the Delaware. In addition, installation of control technology to prevent the clogging of intake pipes could reduce damage.	
Potential for catastrophic impacts (H,M,L) and brief description	L: Although zebra mussels may potentially create catastrophic ecological impacts, these impacts cannot be directly traced to socioeconomic effects.	
Incidence of impacts (affected sub-groups, variability, equity issues)	N/A	
Extent to which threat is currently regulated	There are no current regulations pertaining specifically to zebra mussels. However, on February 3, 1999, President Clinton signed an executive order on the control of alien species. The order instructs all federal agencies to use any means within its disposal to prevent the introduction of invasive species, to fight the spread of invasive species, and to educate the public. The order established an inter-agency council, which was charged with creating a national invasive species management plan within 18 months. The plan was unveiled on July 10, 2000. It calls for increased funding for invasive species control, inter-agency coordination of budgeting, and pilot projects to demonstrate control technologies. In addition, the U.S. has signed, but not ratified, the Convention on Bio Diversity (CBD). Delegates to the Convention are currently debating the ratification of a document prepared by the World Conservation Union entitled "Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species."	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		

NJ Primary Sources	
Large business/industry	M: Shipping and maritime concerns may be placed under this category.
Small business industry	M: Same as above.
Transportation	H: The zebra mussel invasion resulted from a discharge of ballast water from oceangoing vessels.
Residential	L
Agriculture	L
Recreation	H: Recreational boaters can spread zebra mussel larvae.
Resource extraction	L
Government	L
Natural sources/processes	H: Zebra mussels spread through natural reproduction.
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	L
Biota sinks	L
References	Ronald Bailey, 2000. "Preaching ecological xenophobia." National Post, 08/03/2000. Charles R. O'Neill, 1997. "Economic Impact of Zebra Mussel: Results of the 1995 National Zebra Mussel Information Clearinghouse Study." Great Lakes Research Review. Volume 3, Number 1, April 1997. David Pimentel, Lori Lach, Rodolfo Zuniga, and Doug Morrison, 1999. "Environmental and Economic Costs Associated with Non-Indigenous Species in the United States." College of Agriculture and Life Sciences, Cornell University. Mark Sagoff, 2000. "Why exotic species are not as bad as we fear." Chronicle of Higher Education, 6/23/2000. S. A. Thayer, R.C. Haas, R.D. Hunter, and R.H. Kushler, 1997. "Zebra Mussel (Dreissena polymorpha) Effects on Sediment, Other Zoobenthos, and the Diet and Growth of Adult Yellow Perch (Perca flavecens) in Pond Enclosures." Canadian Journal of Fisheries and Aquatic Sciences 54: 1903-1915.

Issue: Zebra Mussels
Author: John Posey
Version: September 2000

	National Invasive Species Council, 2000. United States Invasive Species Draft Management Plan. 7/10/2000. U.S. Census, State Population Estimates, 7/1/99. U.S. Geological Survey, 2000. "Dreissena Polymorpha." http://nas.er.usgs.gov/zebra.mussel/
Current Policy and Regulatory Framework	
Federal	EQTWG reports no current regulations.
State & Local	None to date. A possible proactive regulatory move would be to require all water intake pipe installations to use designs that help control zebra mussel clogging. Such designs are currently in use in European waters affected by zebra mussels.

Zebra mussels are a thumbnail-sized freshwater mollusk. The species is native to the Caspian Sea region of western Asia, and was introduced to the Great Lakes approximately 20 years ago through a discharge of ballast water from a European cargo vessel. Since then, the zebra mussel has invaded 20 states. Zebra mussels can cause local extinction of native mollusks. In addition, zebra mussels can alter ecosystems by consuming aquatic microorganisms that are at the base of the food chain. The most serious socioeconomic impact is the problem of zebra mussels clogging water intake and outflow pipes for water companies and utilities. Currently, in affected states, these costs exceed $5 billion annually. If zebra mussels invade NJ waters, and if NJ suffers proportional costs, then this will result in annual costs of $336 million.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	1	0.1	1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	0.2	0.2	2	0.2	2

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
0.92	**0.92**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	2	2	3	3	3	2.6

Trend: --

Catastrophic Potential: L

Issue: Zinc
Author: John Posey
Version: 07/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Zinc

The following is taken from the *Handbook of Toxic and Hazardous Chemicals and Carcinogens*, 3rd edition, 1991:

"Zinc is used most commonly as a protective coating of other metals. In addition, it is used in alloy such as bronze and brass, for electrical apparatus in many common goods, and in organic chemical extractions and reductions. Zinc chloride is a primary ingredient in smoke bombs used by military for screening purposes, crowd dispersal and occasionally in fire fighting exercises by both military and civilian communities. In pharmaceuticals, salts of zinc are used as solubilizing agents in many drugs, including insulin….There are no U.S. or foreign standards for zinc metal in air."

The following is taken from *The Dictionary of Substances and their Effects*, 2nd edition, 1999:

"[Zinc is an] essential element in mammalian metabolism. Human dietary requirement for zinc 2-20 mg/day, depending on dietary intake of protein and phosphorus. Severe zinc deficiency causes bulbous pustular dermatitis, diarrhea, alopecia, mental disturbances and immune disorders. Moderate deficiency may cause growth retardation, male hypergonadism, skin changes, poor appetite, mental lethargy, delayed wound healing and abnormal dark adaptation. Marginal deficiency is characterized by neurosensory changes, oligospermia and decreased testosterone in males, hyperammoniamia, decrease IL-2 production, decreased immune response, impaired neuropsychological functions and decreased ethanol clearance. Prevalence of zinc deficiency is high in populations consuming large quantities of cereal proteins containing high amounts of phytate."

Studies on ecotoxicity have revealed some negative effects of high zinc levels. Certain fish avoid areas of high zinc concentration, and zinc can inhibit the growth of soil microorganisms. In humans, inhalation of zinc can lead to cough, dyspnea, and increased sweating. Researchers have induced sarcomas in animals by direct intratracheal instillation. Cats exposed by inhalation to zinc dust suffered heart problems, and rats fared badly when zinc wires were inserted directly into their brains.

Other studies indicate that zinc has little negative effects on certain human functions. Excess zinc does not appear to cause liver or kidney damage. Clinical evidence indicates that neurological abnormalities do not typically occur in animals or humans exposed to higher than normal levels of zinc in air, water, or food.

Appraisal: Though it is possible to induce negative effects in animals by forcing ingestion or inhalation of large amounts of zinc, there normally is little risk associated with the metal. As noted, there are no U.S. or foreign standards for airborne zinc, and zinc ingestion is deemed safe enough to warrant its use in drugs. Moreover, zinc deficiencies can cause serious health problems in humans and other mammals. It is unlikely that zinc produces measurable negative economic or aesthetic impacts in New Jersey.

A reviewer added the following comment: It is also worth noting that zinc deficiencies would create socioeconomic effects. However, US Dietary needs are being addressed through federal dietary standards, and are therefore not a concern for NJ.

Zinc is a naturally occurring element, which is necessary nutrient for mammals. It is widely used in alloys and metal coatings. Researchers have created negative impacts in animals by introducing large amounts of zinc, whether through ingestion, inhalation, or intratracheal instillation. However, zinc is also used as a solubilizing agent in drugs. This indicates that there is little known risk associated with the ingestion of zinc. There are no U.S. or foreign standards for atmospheric zinc levels. This indicates that there is little known risk associated with the inhalation of zinc. It is unlikely that zinc produces any measurable negative economic or aesthetic impacts in New Jersey.

Socio-economic Impact Evaluation of Environmental Issue:

Issue: Zinc
Author: John Posey
Version: 07/00
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	0.1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	0.1	0.1	0.1	0.1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.1	**0.1**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Confidence
Confidence Level	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: L